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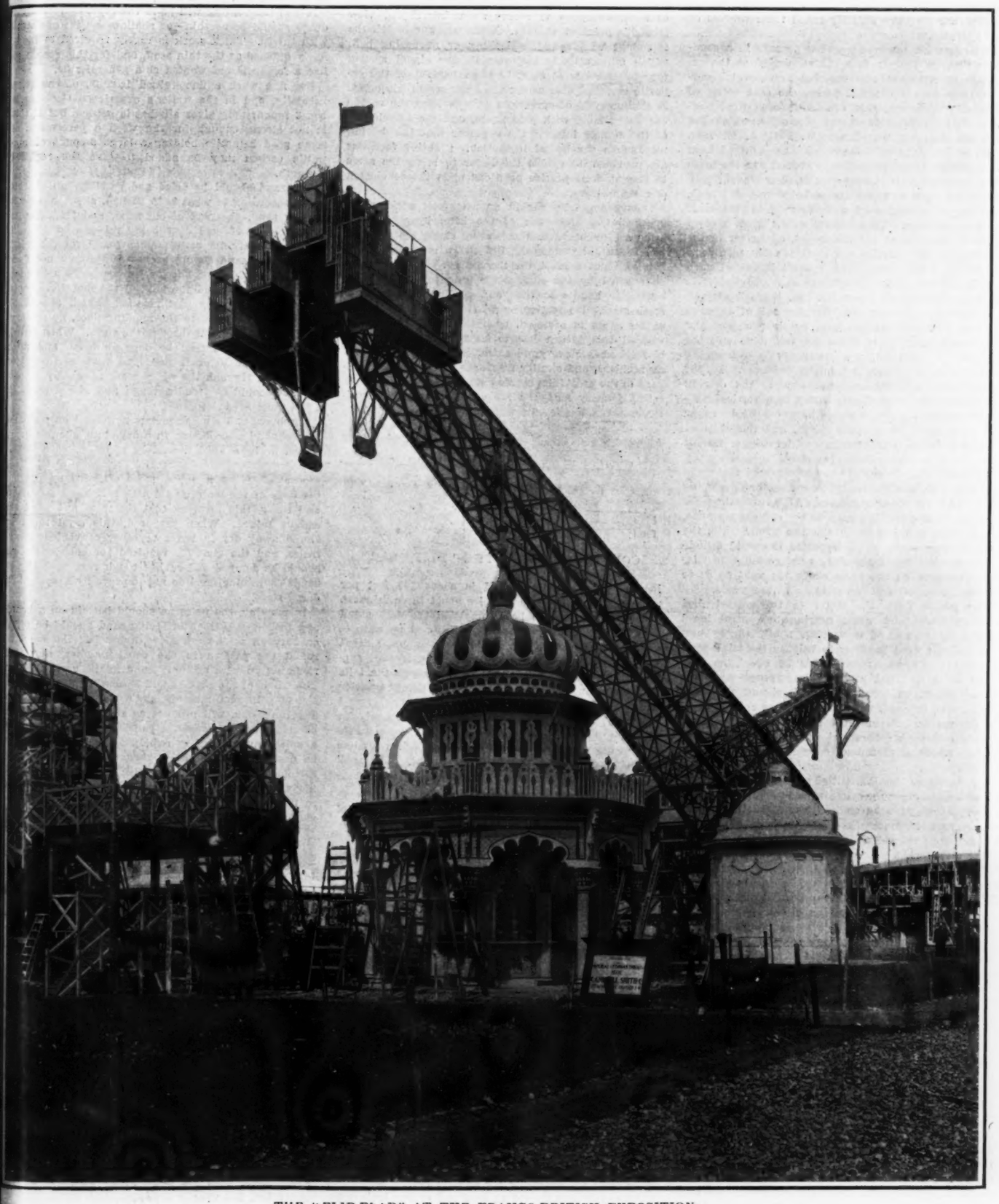


THE "FLIP-FLAP" AT THE FRANCO-BRITISH EXPOSITION.

THE "FLIP-FLAP."

AN AMUSEMENT APPARATUS AT THE FRANCO-BRITISH EXPOSITION.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

SUCCESSIVE expositions have in turn contributed an individual sensational side-show, and in the Franco-British Exhibition the requirements in this direction are fulfilled with the "Flip-Flap." Since it has been in operation this amusement has proved remarkably successful, and the efforts to comply with the demands of the curious to experience a whisk through the air have severely taxed the resources of the apparatus.

The sensation comprises a slow passage in a semicircle through the air in a car suspended at the extremity of either of two tapering arms, which normally rest in a horizontal plane, the cars being so suspended as to maintain constantly a vertical position. The general idea of the apparatus, which has been designed by Mr. Claude W. Hill, A. M. Inst. C. E., of Westminster, London, may be gathered from the accompanying illustration, which shows the arms after completing about a quarter of their travel.

The two arms or masts are each 150 feet in length, built up of latticed steel and tapering toward their outer extremities. These masts swing upon a pivot or shaft placed near the lower end, as shown in the illustration, and carried on steel trestles placed 20 feet above the ground. The over-all length of each arm is 186 feet, and it is pivoted about 36 feet from the lower end, which forms the tail. This latter section carries a balance weight composed of concrete rammed into an iron box, and by its provision not only is the minimum of power required in moving the arms, but it also acts as a safety device, overcoming any liability for an arm to drop suddenly. In the event of an accident or breakdown to the driving mechanism, the arms simply revert to a vertical position, whence they can be easily hauled down by ropes. The cars swing on a center pivot, and the constant vertical position is assured by counterweights carried in the body of the car below the pivot.

The arms, which oscillate in opposite directions, are electrically driven by a shunt-wound motor developing 100 brake horse-power at a speed of 500 revolutions per minute. This motor is placed on the driving platform, which is arranged between the two arms, while the operator's cabin, in which is placed the main switchboard controller and signaling arrangements, is situated also between the arms above the axle, so as to secure a clear view of the working of the masts.

The power from the motor is transmitted first through worm and worm gearing to central bevel wheels by means of a vertical shaft, these bevel wheels being used in order to balance the wind pressure on the arms. Should this be equal, no load attributable to wind pressure is imposed upon the motor; while on the other hand, should the wind pressure be unequal, then the difference only is taken by the motor. From these bevel wheels the power is taken through differential gearing to four driving chains, which drive the set of gearing on either side of each arm.

By means of the differential gearing the wind-pressure stresses on the gearing on each side of the arms are equalized, thereby obviating any twisting strains on the arm itself; also it serves to distribute equally the driving power of the motor.

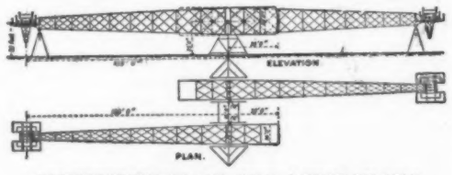
On either side, at the point where the cars rest when the arms are horizontal, is an anchorage and landing station. The cars carry locking bolts, which firmly secure the ends of the arms during the time passengers are embarking or disembarking, while a signal system is also adopted, coinciding with those in the operator's cabin. Emergency switches are also provided which enable the arms to be stopped at any point in their travel in case of accident without communicating with the engineer's cabin, while moreover limit switches are available for applying brakes should the engineer inadvertently allow the arms to travel beyond the landing stages, in which event also the arms come into contact with hydraulic buffer stops, which bring them gently to rest without any violent vibration or shock.

The arms are mounted upon wheels 16 feet in diameter, there being two to each mast, to which each is secured by 146 bolts, so that absolute rigidity is secured. The four driving chains have a maximum pull on each of 1,520 pounds. The brake wheels of the electro-magnetic brake gear are 34 inches in diameter by 4½ inches wide between flanges, with shoes of poplar wood. The solenoid plunger magnets give a pull of 60 pounds with 125 volts on the terminals of the coil, and with the plunger in the outer position. There are four of these solenoids in series in a 500-volt circuit, and the dashpots, though permitting the weights to be lifted quickly, only allow them to go down slowly.

The system of working the apparatus is very simple, passengers embarking simultaneously at either end, each car having accommodation for 48 persons, the internal arrangements of the car being in tiers, to allow everyone to secure an uninterrupted view from his point of vantage. When one car is full the attendant withdraws his locking or anchoring bolt, which automatically indicates by the signal system that he is ready to start to the attendant of the opposite car, and also warns the engineer in his cabin. A similar cycle of operations follows upon the second car being filled with passengers, and the coincidence of the signals informs the engineer that the driving mechanism can be set in motion. Sighting facilities are provided, to enable the latter to bring the arms to rest at their precise positions upon the conclusion of the journey.

During the trip, should an attendant accidentally or purposely close one of the bolts by which the arms are anchored to the landing stage, the mechanism is instantly stopped. But the withdrawal of the bolt will not re-start the machinery. This can only be effected by the engineer, who has to return his controller handle to the "off" position and make a fresh start. No matter by what means the progress of the arms is arrested, once the journey has commenced this return has to be made. It will thus be realized that every precaution is observed to prevent an accident, and similar measures are observed in regard to the propelling mechanism itself.

The journey made by the car is a complete semicircle through the air which is about 470 feet in length. The traveling speed is about 160 feet per minute, so that the trip occupies about three minutes. When the journey is half completed the cars stand side by side, and the passengers being at an altitude of about 170 feet off the ground, have a magnificent view over the exhibition. Between the trestles supporting the axle a pit is provided in which the tails of the arms swing, since in the perpendicular position the ends of the arms are about 16 feet below ground level. Travel is perfectly smooth and without the slightest vibration, the passengers having no sensation of movement. Indeed, the feeling is very similar to that experienced in a balloon ascent. The total cost of the apparatus was approximately $150,000.



CONSTRUCTION OF THE "FLIP-FLAP."

MAKING FINE DETAIL CASTINGS IN SAND.*

By WALTER J. MAY.

FOR many purposes, but chiefly for ornamentation, the production of very fine-surfaced castings in sand is a desirability, and as this depends on the facing of the molds more than anything, any good molder can produce good work in this direction if time is allowed him and he has proper materials provided. As, however, the cost of production has to bear some very decided proportion to the price obtained for the finished articles, really well-finished castings cannot be produced at cut rates, even where machine molding is adopted, and, of course, for castings which are to be machined there is no necessity to produce a fine surface so long as it is clean and sound.

For fine-surfaced work the patterns must be well made and worked up smooth, as every mark on the pattern shows, while in no case may the pattern lift the sand, to secure which point it is necessary that it shall be quite impervious to moisture, a point which is in most cases secured by means of shellac or other hard varnish. Polished metal patterns are best, no doubt, but these are costly to produce, and unless a large number of molds have to be made from them they come too expensive for general use.

The sand used should be good and of fine texture so far as facings are concerned, but as for ordinary purposes not more than ¼ inch thickness of facing is needed, the cost is not so great, the body of the sand in the flasks being preferably of a porous character, as in the case of ordinary molding, although if more porosity is obtained the better it will be. The castings will, of course, be made face downward, that is in the drag half of the flask, and for this reason the whole of the venting will be in the cope, therefore the drags should be as thin—or shallow—as is consistent with safety. Thick work is rarely required to be so finely finished as the thin stuff, and for this reason so fine a facing is not wanted as a general rule.

For fine work a fine-grained iron is, of course, a necessity, and in the writer's experience Gartsherrie No. 3 foundry pig gives all that is needed, but if this is not strong enough for the work a percentage of some good hematite holding a large amount of graphitic carbon may be added to give the required strength.

The sand should be dried and possibly milled, this being according to what is to be had, about two parts of new sand, one part of old sand, and from five to ten per cent of coal dust being mixed and brought to an extremely fine state. When ready, for the finest castings the sand should be passed through not finer than a 50-mesh sieve, but for heavier work a 30-mesh will be sufficient, and the bulk of the material should pass the sieve. The part rejected, which should be small, may be added to the molding floor, no attempt being made to force it through the sieve. When sifted, the facing sand should be damped down, and after lying for some 10 or 12 hours, to allow of the water penetrating through the whole mass as equally as possible, it should be trodden tough and stored away in a bin until needed for use.

For brass and similar metals new sand only should be used, and after sifting in a dry state, about a quart of pea or bean meal should be added to each gallon of fine sand and most intimately mixed with it. This thorough mixing is made more effective by passing the body of the material through a 20-mesh sieve several times, this insuring that the meal and sand are equally mixed. When prepared, this sand must be stored away dry in boxes or other convenient receptacles, and the quantity required for each day's use should be damped and rubbed tough each morning, as sands containing meal do not improve by keeping in a damp state.

In molding, the patterns should be laid on a board, and just over ¼ inch of facing sand should be sifted on through a 16-mesh sieve, trimming the sand up round the pattern in the usual manner, and then ramming up with ordinary sand in the usual manner. The whole of the sand should be used as dry as is consistent with good molding, and when this is done usually the molds will produce as smooth results as can be desired. If, however, a polished surface is desired, a small quantity of extremely fine plumbago should be dusted over the molds through a cloth, and any surplus carefully blown off with the bellows. If yellow alloys are being used, ground steatite can be used in place of plumbago, but this does not give quite so good a result, although it does not stain the metal. It is very rarely that molds of this kind can be sleeked with tools, but usually they can be touched up with a camel-hair brush if considerable care is taken, but this very much depends on what time can be spent on the work. As a matter of possibility it is quite an easy matter to produce a highly-polished mold, giving a perfectly smooth casting, but time is the factor which determines what shall be done.

Pouring must be done very carefully when dealing with fine work, or there will be considerable risk of washing away fine details. Each mold will need its own gating, according to shape and other practical details, but in no case should the flow of metal impinge on the fine surface of the mold with any great force. In some cases a little metal may wash over the top of the mold to carry off dirt, but the practical experience of the molder must determine this point, and also the exact method of both gating and arranging runners and risers.

Fluid metal is always necessary for pouring fine detail work, and it is necessary to arrange the venting so that air and gases do not become inclosed in corners and pockets in the mold, but these are, of course, matters of detail quite obvious to practical molders. Fluid metal does not mean metal which is unnecessarily hot, but usually it means clean metal, and this is a thing which every melter can get if he goes the right way to work.

* Practical Engineer.

OPERATION OF COAL-CUTTING MACHINERY.*

USE AND ECONOMY OF THE VARIOUS TYPES OF COAL CUTTERS.

BY GEORGE E. LYNCH.

THE production of bituminous coal offers a field for the employment of machinery more favorable than that presented by any other class of mining. This has led to the development of highly specialized machines suitable for this work alone, and almost unknown to those whose operations are confined to the harder minerals.

While the difficulties and dangers encountered in producing coal are not, except when complicated by the presence of gas, any greater than those overcome by ore miners, the friable nature of the coal itself offers a better opportunity for machine mining, and engineers have not been slow in taking advantage of this.

In most modern mines, the coal is undercut and drilled for shooting down by electric or compressed-air machines, and hauled to the shaft bottom or tipple by electric or compressed-air locomotives. In cases it is even loaded into cars underground by the same power.

The commercial machines of the present time may be divided roughly into two classes; the percussion or puncher type which imitates the action of a hand miner's pick, and the chain and cutter-bar machines which use the continuous cutting effect of a series of tools or picks working in a manner similar to a milling cutter in metal or a circular saw in wood.

THE PERCUSSION TYPE OF MACHINE.

The puncher has proved a satisfactory machine in practice and is adapted for use in many places when the second type is nearly, if not quite, useless. Its mechanism is not unlike that of a small steam pump with the water cylinder omitted. The piston and rod are made heavy and are guided by an extension of the front cylinder head; the outer end of the rod is fitted with a taper socket or chuck adapted to hold a single, double-pointed pick. The machine is mounted on low wheels and furnished with a pair of handles at the rear end of the cylinder. The motive power is always compressed air, for there is, as yet, no practical electrically driven puncher on the market.

In use the puncher is placed on a sloping platform called the "board," the front end of which rests against the coal face, the rear end being elevated on a low trestle or "horse." The object of the slope is, of course, to overcome and neutralize the effect of the recoil at each stroke. The runner sits on the board back of his machine and blocks one wheel with a wooden clog strapped to his foot, guiding the direction of each blow of the pick by the handles, already mentioned. A second man, called the "scraper," kneels on the floor by the board and keeps the cut clear with a long-handled shovel.

The completed undercut is about 6 feet wide and 4 to 6 feet deep, and is wedge-shaped in section, the height decreasing from about 18 or 20 inches at the face to 2 or 4 inches at the extreme depth. This wedge form of the undercut is very effective in causing the coal to roll over and break up when shot, rendering it easier to load.

The puncher with its board is shifted along the face about 6 feet as each cut is finished until the whole place is under-cut. In room and pillar work the miner usually starts at the corner of the room, so that when the work is completed it is unnecessary to drag the machine and board over the accumulated slack and cuttings in shifting to the next place. Each puncher is supplied with a special low truck of a gage to fit the mine tracks upon which it is loaded with its board, coil of hose, box of picks, etc., when moving about the mine.

THE DIFFERENT MAKES OF PUNCHING MACHINES.

There are several makes of punchers on the market, all similar in outward appearance and efficiency and differing principally in the valve gear. All receive air through a large main valve which is in turn governed by a smaller auxiliary valve. In the Sullivan puncher, this auxiliary valve is driven directly from the main piston by means of a rifle bar with a pinion engaging a rack. A movable false seat under the auxiliary valve may be adjusted by the operator while the machine is running, thus advancing or retarding its stroke and consequently governing the movement of the main piston. In the Ingersoll-Rand, the Harrison, and other standard punchers, the auxiliary valve is moved by a small engine independent of the main piston, its action being under the control of the operator as in the previous case.

Each puncher, in the hands of an efficient runner, will average 60 to 70 feet of face undercut per 10-hour shift. The power consumption is from 100 to 150 cubic feet of free air compressed to 80-pound gage per minute, thus giving a speed of about two strokes per second, which is regarded as the most economical rate of running. Any higher speed tends to disconcert the runner so that he is unable to place each stroke to the best advantage. The working efficiency of a pick-machine plant is very low. After deducting losses due to the compressor, friction, pipe line, leakage, etc., the resulting power applied to the coal is rarely more than 12 per cent of the horse-power supplied at the steam cylinder of the compressor.

A NEW TYPE OF CUTTER.

A new type of percussion coal cutter has been introduced in the last few years which consists essentially of a rock drill mounted on a mining column and arranged to be swung in an arc across the face by means of a worm and sector. A series of steels of varying length, each carrying a bit of proper gage, are used just as in ordinary rock-drill work, except that instead of pounding away at one spot, this drill swings radially and cuts a groove 10 to 15 feet long, advancing ⅝ to ¾ inch each swing. Machines of this type have been successfully used abroad. These European machines, however, are provided with universal adjustment so that the drill may swing at any desired angle regardless of the setting of the column; this is a patented feature not used on those made in this country, since the latter are capable of a horizontal and a vertical swing only.

Coal cutters of this type may be used for shearing, when the coal will not stand undercutting, by setting the worm sector to swing in a vertical plane without any other change. When a room is cut, the machine may be clamped in place and the holes drilled for shooting with the same steels working as a rock drill.

The danger of a long cut closing and stopping the swing of the steel is a serious disadvantage with this machine. There is also considerable difficulty in holding a column up against a greasy surface of slate or roof coal, a trouble experienced even with the small power rotary drills and naturally much augmented by the repeated shocks of a percussion machine.

The Stanley header was designed to drive a complete gangway or tunnel at one cut. It consisted of a disk of large diameter rotated on a horizontal axis by a duplex air engine or an electric motor; the front face of the disk was provided with a number of cutting tools. The whole machine was mounted on a heavy truck and forced against the coal face. A conveyer was arranged to take the slack and cuttings to the rear where they were loaded into cars. This machine proved unsuitable for American conditions and is now practically obsolete.

Some attempts are being made at the present time to perfect a machine which will do the cutting and the loading at the same operation. These machines are, however, more or less experimental and it is as yet impossible to form any definite opinion of their capabilities.

One of the earliest continuous-cutting machines to obtain success was the old cutter-bar type now almost obsolete in this country, although still used to some extent in England. This machine employed a tapering bar of steel, of a length sufficient to give the proper depth of undercut, in which a number of picks or tools were set. The bar was rotated by a compressed air engine or an electric motor and cut the coal in a manner similar to a surface mill in working metal. The picks were arranged in a line along the bar with the object of clearing away the cutting and preventing sticking by a sort of screw conveyer action.

While this machine was strong and simple in construction, it was found nearly impossible to maintain a level cut in irregular coal, as the bar was easily forced upward or downward by hard spots of sulphur or by "horse-backs" in the bottom and was with difficulty returned to the proper level. This led either to a set of broken picks when they encountered a limestone floor, or a job of taking up bottom where the bar had worked upward.

The disk-longwall machine was also popular for a time and is still used to some extent. This machine imitated the action of a circular saw, the cutting tools being mounted on the periphery of a large steel disk, set horizontally and driven by bevel gearing from an air engine or electric motor. The central bearing was made short and supported by steel plates above and below the disk so that almost the entire diameter was available for extending under the coal.

Since in longwall working some pressure and consequent settling of the coal is essential to easy shooting down, it is obvious that there was a continual pressure on the rearmost edge of the disk and that practically the whole active edge was required to work continuously after the cut had progressed a few yards. This caused a large consumption of power and a consequent low efficiency of the machine.

THE CHAIN COAL-CUTTER.

The chain coal-cutter has been standard for a number of years and is used in practically every field in the country. There are two types adapted for room-and-pillar work, the chain-breast and the so-called continuous-cutting machine, which is a modified longwall type.

The chain-breast machine is made up of two essential parts; a stationary base or frame which rests on the floor, and is clamped down while the machine is running by jacks set obliquely at either end and bearing against the coal face and the roof respectively; and a movable triangular cutting frame carrying a chain, provided with picks or cutters, on sheave wheels at its angles. The motor or engine is fastened rigidly to the triangle at its apex, the base being presented to the coal. The frame with its motor travels in and out in guides on the stationary base or carriage, the feed being accomplished by a rack and pinion. A cut 30 to 40 inches wide and 5 to 7 feet deep is made at each setting, the height of cut varying from 4 to 5½ inches according to the setting of the picks. The cutter frame is then withdrawn and the whole machine moved over by hand a distance equal to the width of the cut where the same procedure as before is followed, the operation being repeated until the entire face is undercut. The machine is then drawn away from the face and loaded on a special truck built for the purpose, ready to be moved to the next place.

Each chain-breast machine requires the services of two men, a machine runner and a helper, the latter keeping the cut clear of slack and assisting in moving and loading the machine. A skillful operator will undercut from 150 to 180 feet of face per shift. The electric machines require about 12 kilowatts equal to 48 amperes at 250 volts, or 105 amperes at 115 volts, and the compressed-air machines about 400 cubic feet of free air compressed to 80-pound gage per minute when running at full power.

ADVANTAGES AND DISADVANTAGES.

The advantages of this machine lie in the smaller number of men required to produce a given tonnage as compared with pick machines or hand labor, its greater mechanical efficiency, and the higher percentage of lump coal due to the low kerf or undercut which it makes.

Its disadvantages may be stated as the difficulty of obtaining a level floor, the necessity of placing all props 10 feet to 14 feet back from the face to allow of its working, the liability of pinching the wide cutter frame in any settling of the coal, and the labor involved in moving the machines by hand along the face after every cut.

To overcome these disadvantages the continuous-cutting machine was developed. There is at present but one of this type on the market, but it is probable that most other manufacturers will have machines running on this principle in the near future.

The continuous-cutter is essentially a longwall machine modified to adapt itself to room-and-pillar work. The cutter frame is narrow and carries a single sheave at either end; the construction otherwise is similar to that previously described. In the starting or "tight" cut, the cutter frame is fed in as before, the feed being accomplished by a chain instead of a rack and pinion in the machine under discussion. The rear portion of the underframe is then detached, and the feed chain is extended the length of the face, and fastened securely at either end to a steel prop or jack provided for the purpose; the whole machine is drawn along the face, making a continuous undercut from end to end. At the further end of the room, the cutter frame is withdrawn, the detached portion of the underframe being replaced for the purpose, and the machine is then loaded on a truck as before described.

The fact that this coal-cutter traverses the width of the room with the cutter frame under the coal, allows the setting of props close to the face, since the space necessary for working is only that taken up by the motor and feed mechanism and this does not exceed 3 feet in most cases.

Both this machine and the chain-breast type are usually provided with a sprocket wheel and chain or other mechanical connection with the axle of the truck so that they may be moved about the mine by their own power, the cutter chain drive being, of course, thrown out of action by some form of clutch.

POINTS TO CONSIDER.

While the chain coal-cutter represents the highest development of the mining machine at the present time,

*Engineering and Mining Journal.

it is by no means conceded that it is, necessarily, the form best suited to the work. The internal friction due to the large number of chain joints, and the sliding contact on the guides, all of which may be regarded as constantly under the coal, and consequently difficult to lubricate, causes a serious loss of mechanical efficiency. Indeed, those machines which employ a high speed chain waste more than 50 per cent of the power supplied at the terminals of the motor or the throttle valve of the air engine in overcoming this internal loss. Another serious difficulty is encountered when cutting in high seams, from the fact that the coal tends simply to settle down the height of the undercut, when shot, and does not roll over and break up as it does when cut with the puncher. This necessitates a second shot to break up the mass, and makes it almost as difficult as shotting off the solid in the first place.

It is not impossible that we may be compelled to return to some modified form of the old cutter-bar machine to avoid these troubles. The bar itself could be built up of cast-steel skeleton sections to form a screw conveyor of a pronounced conical shape, the cutting tools being set on the edge, the whole assembled on a stout steel shaft. A steel frame attached to the body of the machine and traveling behind the bar in the undercut, its form being similar to a longitudinal section of the bar itself, would assist in preserving the level of the cut. This frame could be inserted after the work had progressed a few yards, or could be attached rigidly to the machine, the latter construction necessitating a radial swing of the bar under the coal in starting and there leaving a corner uncut.

A coal-cutter of this type could be made very strong and simple in construction and the small number of bearings and rigidity of the mechanism should aid greatly in reducing the internal friction. The construction of such a machine would naturally introduce a number of problems which could be solved only by actual experience in cutting coal.

HIGH-FREQUENCY OSCILLATIONS.*

THEIR PRODUCTION BY VARIOUS METHODS.

BY WILLIAM DUDDELL, F.R.S.

The use of high frequency currents in connection with wireless telegraphy has given a great impetus to the development of the various methods of production and I propose to pass in review some of the different methods of producing high frequency currents which have been tried.

Let us go right back to the beginning. A direct current such as is obtained from a battery flows round a closed circuit constantly in the same direction. If the current is periodically reversed by any means, for example by a commutator, then it is called an alternating current. And the number of times in a second that the current round the circuit is reversed and re-reversed back to its original direction is called the frequency.

The alternating current supplied by some of the electric light companies has a frequency of from 50 to 83 periods or complete reversals per second. The much smaller alternating current which is generated in telephone circuits when a musical note is whistled or sung before a telephone has a much higher frequency, ranging up to 1,000 or 2,000 periods per second. If the frequency is very much higher, ranging from 100,000 up to several million periods per second, it is usual to speak of the current as high frequency current.

There are broadly two methods by which high frequency currents may be produced:

Firstly. An alternator or some mechanical method of producing the reversal of the current might be employed.

Secondly. The current reversals can be obtained by taking advantage of Lord Kelvin's discovery of the nature of the discharge of a Leyden jar or condenser.

Taking the alternator first, the difficulty in constructing such a machine is very great, mainly due to the very high frequency required. Whether the attempt is made to build a dynamo with little poles placed very close together or whether a contact maker is constructed with little contacts very close together round its circumference, the difficulty is encountered

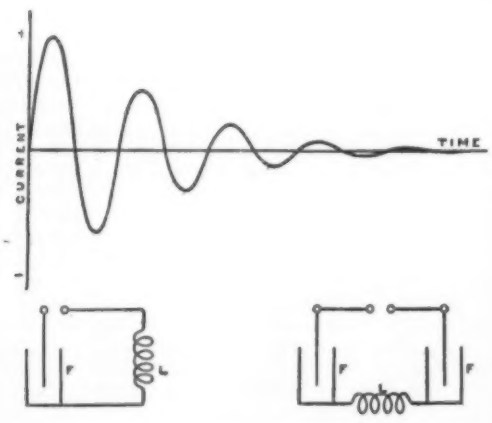


Fig. 1.

of the want of sufficient space for the poles or contacts. If the small distance of only 1/10 inch is allowed for each pair of poles or contacts and it is required to obtain a frequency of half a million, a frequency which, I believe, is very usual for therapeutical purposes, the speed at which our contacts or poles must move is 500,000 times 1/10 inch per second, which works out at 50,000 inches or 1,388 yards per second or 2,840 miles an hour. Now there is no known material, not even the strongest steel, which will stand being rotated with such a surface velocity as this.

Small alternators have been constructed for lower frequencies such as a machine that I constructed some years ago which gave 120,000 frequency, but a very small output. Lately Prof. Fessenden in America claims to have constructed an alternator having a frequency of a little over 80,000 which will give a

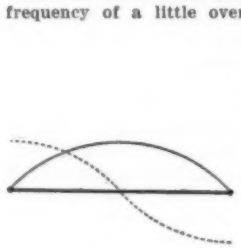


Fig. 2.

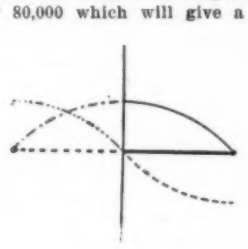


Fig. 3.

considerable amount of power. I fear, however, that this frequency is somewhat low for medical applications, though I am not clear on this point. It is a matter in which the medical men can help me.

Turning next to the methods of producing high frequency currents by means of the discharge of a Leyden jar. As far back as 1853 Lord Kelvin mathematically demonstrated that when a charged Leyden jar is discharged the current, instead of flowing continuously in one direction round the discharge circuit, may flow round this circuit first in one direction, and then in the opposite, and then round in the original direction, gradually dying away until the jar is completely discharged as represented graphically in Fig. 1. This property of the Leyden jar forms the basis of all our present practical methods of producing very high frequency currents.

Lord Kelvin pointed out that in order to obtain this oscillatory discharge it is necessary first, that the conductor through which the jar is discharged should possess self induction, and secondly, that the resistance of the conductor should be sufficiently low. Lord Kelvin also gave a simple formula for calculating the frequency of these oscillations, namely, the frequency is equal to $\frac{1}{2\pi \sqrt{L.F.}}$ where L is the self-induction of the circuit, and F is the capacity of the jar or condenser. The movement of the electricity in the conductor during the discharge of the jar may be illustrated by taking as an analogy the movement of a pendulum which when started swinging gradually stops.

I have mentioned this elementary matter in order to have it fresh in your minds as it is the basis of all the following methods of producing high frequency currents. In order to obtain energetic oscillations in the circuit the condenser must be charged to as high a voltage as possible, and then allowed to discharge. To do this there are two methods now in use which I will designate briefly as the "arc" and the "spark" methods. The latter method was so brilliantly worked out by Nikola Tesla in his classical researches, and is so well known, that I shall not need to dwell very long over it. It is the method, I believe, universally used by medical men. The method consists, briefly, in periodically charging the Leyden jar or condenser by means of an induction coil when direct current is used, or by means of a transformer when alternating current is used. The discharge is obtained by allowing a spark to take place at some point in the discharge circuit. This spark takes place when the condenser is charged to a sufficiently high voltage to break down the air between the terminals of the spark gap. The properties that are required in the spark gap in order to make it effective are that it shall be a very good insulator for electricity, and so allow the condenser to charge to a sufficiently high voltage, and then when once the spark has taken place it is necessary that the gap should become so good a conductor as to allow the oscillations to take place freely. The property of the spark gap passing suddenly from an insulating condition to being a very good conductor is the foundation of the present spark methods of producing high frequency oscillations.

When it is required to deal with large powers the spark gap may become so heated during the discharge that it does not return to its insulating condition sufficiently rapidly to allow the condenser to be charged again by the induction coil or transformer. To overcome this difficulty various devices are used, such as cooling the electrodes, blowing air across the spark gap, etc.

In order to utilize, whether for wireless telegraphy or medical purposes, the high frequency oscillations obtained by the discharge of the jar, it is usual to associate with the discharge circuit some form of transformer or oscillation spiral to raise the voltage. The action of these resonant circuits is often puzzling to those who are unaccustomed to them. In order to try and make the matter more clear let us consider a long, straight conductor insulated along its whole length, and removed to a distance from all other bodies. Suppose that one end of this conductor be suddenly charged. The electricity will not reach the other end instantaneously, but will travel along the conductor with approximately the velocity of light. When the charge reaches the far end of the conductor it will, in general, be reflected in much the same way as sound waves are reflected at the end of a closed organ pipe, so that a certain quantity of electricity flows backward and forward along the conductor until finally the steady state of charge is reached.

The middle of this conductor is traversed by a high frequency alternating current, and at each end there is produced a high alternating voltage which dies away. These oscillations of the electricity along the conductor will be produced each time that the conductor is charged and discharged in much the same manner as in the discharge of a Leyden jar.

The maximum value of the oscillatory current at

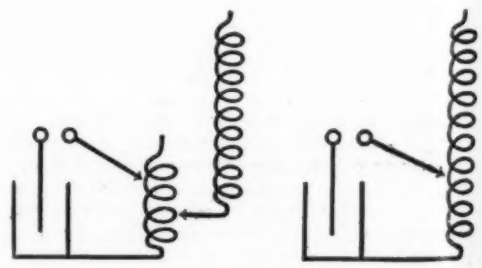


Fig. 4.

each point along a complete insulated conductor may be illustrated as shown by the full lines in Fig. 2, when the oscillations take the simplest form, and the maximum value of the potential may be represented by the dotted lines.

The frequency of these oscillations may be roughly estimated in the following way: The electricity starting from one end travels to the far end and returns to the starting point with the velocity of light, so that the electricity travels twice the length of the conductor in a time roughly equal to $\frac{2l}{v}$. Where l is the

* From a presidential address before the Roentgen Society, London.

length of the conductors, and v is the velocity of light, the frequency of the oscillations in this conductor will be $\frac{v}{2l}$. Now the 2 in the above expression is not strictly accurate. For a long insulated conductor experiment shows that the value should be 2.4 or 2.5. For conductors wound in spirals and other shapes the constant may have higher values. If the conductor is connected to earth at one end, or to any other very large conducting body, then the conductor behaves as if it was increased by adding to it a similar conductor placed below the surface of the conducting body, in much the same way that it would appear to the eye to be increased if the conducting body was replaced by a mirror. In this case the maximum value of the

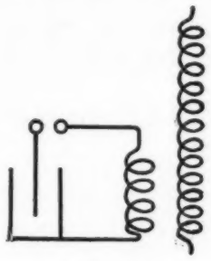


FIG. 5.

oscillation current and potential may be represented as shown in Fig. 3.

The importance of the difference between these two modes of oscillation of the conductor is very great, as the frequency of the oscillations when the conductor or spiral is earthed at one end is one-half of that in the completely insulated case. Thus the same spiral will require two different adjustments of the oscillatory circuit to which it is applied, according to whether one end of it is earthed or connected to any large conducting body, or whether it is insulated along its whole length.

Very violent oscillations may be set up in such a conductor by using quite a small amount of energy if the voltage applied to start the oscillations has the same frequency as the oscillations would have in the conductor if left to itself. If in such a circuit either a straight wire or a wire coiled in a spiral be connected to the discharge circuit of a Leyden jar, and if matters are adjusted so that the frequency of the oscillations in the discharge circuit of the jar is the same as the frequency of the oscillations in the associated spiral, then very violent oscillations may be produced in this latter spiral accompanied by the well known brush discharge and other effects. The adjustment of the two circuits to one another is usually spoken of as tuning, in analogy to the adjustment of two musical notes to exactly the same pitch or frequency.

There are various ways by which the discharge circuit of the jar may be connected to the oscillatory spiral. They may be divided into two main groups, the direct connection (see Fig. 4) and the indirect or transformer method (see Fig. 5). Much might be said on the subject of which is the best method to use, but in my own opinion there is very little to choose between them provided that the circuits are arranged

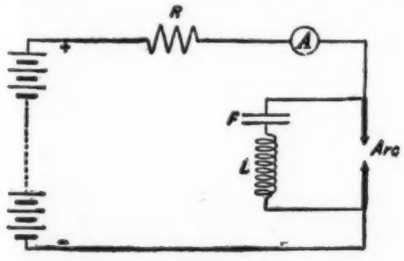


FIG. 6.

so that each method shall be used to its best advantage.

The actual shape and form of the oscillation spiral will largely depend on the purposes for which it is to be used. The oscillation spirals of which I have had most experience are plain vertical wires raised to a great height in the air and used in wireless telegraphy. For medical purposes such conductors would be useless, as the high potential points at the extreme ends are quite out of reach.

The spirals used for medical purposes are designed to suit the special applications for which they are intended. The design should consist not only in making the shape of the spiral suitable to the application required by medical men, but should be such as to give it the required electrical constants to enable it to oscillate freely. And further its length and size will be determined by the frequency required. Given a suitable oscillation spiral there is no particular difficulty in adjusting a discharge circuit to work it to the best advantage, provided that its frequency is not outside what may be termed the practical range, namely, from say 10,000 to a million. With frequencies much above a million, practical difficulties arise in that the size of the Leyden jars becomes very small and the voltage they have to support very high. At the other end of the scale, namely, for very low frequencies, there seems to be no limit except the cost of constructing very large apparatus.

It is to be noted that the spiral may be made to oscillate without the use of a jar and oscillation circuit by simply charging it and allowing it to discharge through a spark gap. I am not aware that this method of exciting it is used by medical men. It seems unsuitable owing to the danger of shock from the spiral.

Turning next to the newer method of producing high frequency oscillations, namely, the arc method. This method is based on what is known as the musical arc. If we take an ordinary direct current arc burning between solid carbons (Fig. 6) and connect between the carbons a circuit consisting of a condenser and a spiral of wire or self induction in series, then if these are suitably adjusted, oscillations will be set up in the condenser circuit which will go on continuously. I said take an arc between solid carbons; the reason for this is that if the current through the solid carbon arc gradually increased, the potential difference or voltage between the two carbons will decrease; if the current is decreased the voltage will increase, as shown in Mrs. Ayrton's well-known curves. Now when an oscillatory circuit is connected to such an arc the condenser starts to charge and in doing so takes away some of the current from the arc and causes the voltage between the carbons to rise above its normal value. This tends to make the condenser overcharge itself, and the condenser discharges through the arc causing the arc current to increase and the voltage to decrease so that the condenser over discharges itself. The condenser then begins to charge again and the same series of events is repeated, the jar periodically overcharging and discharging itself without interruption, producing an alternating current.

In order to obtain energetic oscillations it is necessary that the change in voltage produced by a given change in current should be large and in the opposite direction to the change in current or, in other words, that the arc should be operated on the steep part of a characteristic curve which slopes downward with increasing current. And further it is necessary that an increase in current should produce a decrease in the potential difference even when the rate of variation of the current is very rapid.

The frequency of this current is determined exactly in the same way as that of the discharge of a Leyden jar, namely, by the self-induction and the capacity in the circuit.

The alternating current flowing through the arc causes the vapor column of the arc to grow bigger and smaller, thus displacing the air round it periodically and producing sound, the pitch of which depends on the frequency of the current in the shunt circuit, hence I gave the name of "musical arc" to the phenomenon. If it is attempted to obtain very high frequency currents by reducing the size of the condenser and self-induction, the oscillations finally fail to take place. With the arc taking large currents, the limit is soon reached at 20 or 30 thousand frequency. With very small current arcs it is quite possible to produce frequencies up to a million or so, but the amount of available power is small.

Mr. Poulsen has shown that by placing the arc in hydrogen or coal gas instead of in air and by employing a transverse magnetic field arranged as shown in Fig. 7, it is possible to obtain high frequencies even when a considerable current is flowing through the arc. In this way high frequency alternating currents of considerable power can be produced at practically any frequency from a million or two downward. Mr. Upson has recently shown that the arc in hydrogen has a very steep characteristic sloping in the right direction which accounts for its good working.

A question arises: What is the difference between the high frequency current generated by the arc method and that produced by the spark method? The fundamental difference is that in the case of the arc method the current is oscillating practically continuously without any intermission, whereas in the spark method a limited number of oscillations, say 20 or 30, are produced, corresponding to each spark at the spark gap and then a very long interval of time, relatively speaking, elapses before another train of oscillations is set up by means of another spark at the gap. The relative magnitude of the time taken by the train of oscillations and the interval between one train of oscillations and the next is best illustrated by an example. Suppose the frequency of the oscillations is half a million and that we have a long train of say 50 oscillations, then the time taken by the train of oscillations is 1/10,000 of a second. With an ordinary induction coil the number of sparks per second does not generally exceed 50, with mercury or vibrating breaks; with electrolytic interrupters the number may reach some hundreds per second.

If we take the number of sparks per second as 100 the time interval between exciting sparks is 1/100 of a second and the duration of each train is 1/10,000 of a second, that is to say that the two times are in the ratio of 100 to 1.

Suppose that the oscillations were distinctly visible to the eye, say like a lamp which flickers five times per second, then 50 oscillations, or flickers, would last ten seconds and the interval before another set of oscillations or flickers would be 1,000 seconds, or over a quarter of an hour. This gives some idea of the very long pauses which exist between the trains of oscillations as produced by the spark method.

With the arc method these pauses are practically non-existent. One result of this is that the heating

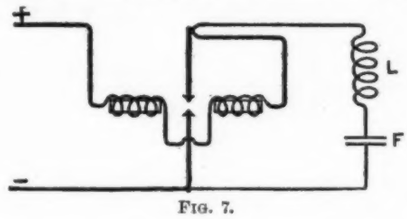


FIG. 7.

effect of the oscillations is very marked, so that although, owing to their high frequency, one feels no sensation of shock from them, yet the burns which may be produced should a discharge be inadvertently taken on the bare skin are serious. How far this property may be an advantage or a disadvantage in the medical application of this method of producing high frequency current I do not know. It seems possible that the continuity may quicken their action, and that burning may be of use where it is required to suddenly produce intense local heating of the skin. Of course, the burning action of the discharge can be largely reduced by limiting the amount of power used. In the practical application of this method of producing oscillations the ordinary forms of oscillating spirals may be connected to the oscillating circuit, in a similar manner to that used with the spark method. In fact, as far as the apparatus is concerned, the main difference consists in that we replace the spark gap, and the induction coil or transformer which supplied it, with an arc burning in hydrogen or coal gas supplied from a 200-volt or by a 400-volt direct-current circuit.

There is one practical point to which I should like to call attention, namely, that the arc method is more suitable for the production of oscillations of a comparatively low frequency, say from a million downward, than for frequencies above this limit, as the arc does not generate very high frequencies so easily.

There is another method which has been proposed for the production of high frequency currents, namely, Mr. S. G. Brown's method, in which a light contact is made between a block of copper on a revolving aluminium disk, Fig. 8. Direct current is passed through this contact in series with a high self-induction, and the contact is shunted by a condenser and self-induction in a similar way to the arc. In fact, the loose contact replaces the arc.

With this method I have, so far, been unable to produce such powerful high frequency currents as with the arc. Possibly this is due to the small scale on which my apparatus is built, which makes it difficult to handle a direct current passing through the

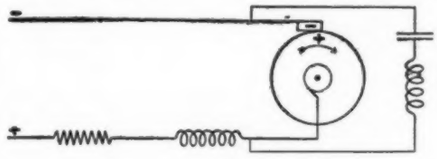


FIG. 8.

contact exceeding about 1 ampere without excessive sparking taking place. The appearance of the fine sparks under the contact when at work leads me to think that in reality we are dealing here with small, very unstable arcs at the contact, and that it is really the shunting of these arcs by the condenser and self-induction that produces the high frequency oscillations in the same way as in the musical arc.

Another explanation is that the light contact on the revolving disk acts as an interrupter. In working the edge of the disk rapidly becomes covered with a film of oxide, which is practically an insulator, and it might be said that this film has some microscopic defects in it which allows the current to pass and be interrupted very rapidly. As the contact is placed in series with a high self-induction, such an interrupter would give rise to oscillatory currents in the shunt circuit. In favor of this explanation is the

fact that when the current in the oscillatory circuit is investigated it is found that the oscillations appear to occur in groups, and not to go on continuously all the time.

If the potential difference between the terminals of a conductor of electricity decreases when the current through the conductor is increased, and, *vice versa*, increases when the current is decreased, such a conductor may be said to be unstable. This instability may only manifest itself when the current is varied slowly; in fact, most unstable conductors appear to become stable, that is, an increase in the current is accompanied by the increase in potential difference if the current is only changed quickly enough. According to my views, all the unstable conductors can be made to give oscillations when shunted by a self-induction and capacity, provided that the frequency of the oscillations is not so great as to vary the current through the conductor so rapidly that it is stable for this rate of change of current. There are a large number of known unstable conductors from which it should be possible to produce alternating currents. The arc has, so far, been the only one employed in practice. The discharge in vacuum tubes is under some conditions unstable, and may be used to produce high frequency currents, but I have not yet obtained any large amount of power by this means. The filament of a Nernst lamp is also an unstable conductor, but becomes stable at such moderate rates of variation of the current that I have never been able to get even low frequencies from it, although it has been stated in the German press that it is possible to get it to work at high frequencies. Some electrolytic conductors are also unstable, and I have no doubt many others will be found.

There is here a wide field for experiment to find simple and convenient unstable conductors which can be used to produce high frequency currents of moderate power such as are required for medical purposes. It seems to me that there will be a great advantage in the treatment of disease in doing away with the use of an induction coil and attendant spark gap, and replacing them with a steady and very silent method of producing the required high frequency currents.

A NEW METHOD OF DESICCATION.

HOW LIQUIDS READILY DECOMPOSABLE BY HEAT MAY BE DRIED.

BY E. HAUSBRAND.

MOST organic liquids are more or less altered by heating, even to the boiling point of water, the extent of the alteration depending on the elevation of temperature and the time during which it is applied. For this reason vacuum apparatus is frequently employed in concentrating such liquids or evaporating them to dryness. A vacuum dryer is essentially a closed vessel from which both air and water vapor are removed by air pumps, so that a lower pressure and a correspondingly low boiling point are produced in the vessel.

The vacuum method is not always applicable in practice and in some cases it may advantageously be replaced by a method based on the following principles: If a vessel partly filled with water, and communicating with the outer air by means of a single small aperture, is gradually heated, vapor is formed even at low temperatures. A little of this vapor is condensed by radiation and by conduction of heat to the imprisoned air and the walls of the vessel, the rest remains in the state of vapor, diffused through the air. As the vessel is not completely closed the total pressure of the mixture of air and vapor is equal to the atmospheric pressure outside. The pressure of the vapor depends on its temperature and that of the water being equal to the maximum vapor tension of water at that temperature. Hence the pressure of the inclosed air must be less than one atmosphere by the amount of this vapor tension, and to produce this result part of the air must be expelled through the small aperture. As the supply of heat is increased the temperature gradually rises. Hence the vapor tension continually increases and the air pressure diminishes, the sum of the two being always one atmosphere. Finally, when the water has been heated to the boiling point the tension of the vapor alone is one atmosphere and there is no air pressure within the vessel, from which the air has been completely expelled.

But if a stream of air sufficient to take up and carry away all the water vapor is blown through the vessel, the temperature of the water can never rise to the boiling point, because part of the total pressure of one atmosphere is air pressure and only the remainder is left for the vapor tension which, therefore, cannot rise to the value (one atmosphere) which corresponds to the boiling point. By regulating the current of air the vapor tension can be controlled and the temperature of the liquid kept at any desired degree below the boiling point while rapid evaporation is maintained.

In accordance with these principles Otto Nicolai has constructed evaporating apparatus which in practical use has demonstrated its efficiency in the condensation and desiccation, without injury, of milk and many pharmaceutical and other solutions of substances easily decomposed by heat. The apparatus consists of a large horizontal cylinder, open below and nearly filled by a steam-heated drum which rotates slowly and is kept coated with the liquid by a roller half immersed in a trough. The roller rotates so that its top moves in the same direction as the bottom of the drum, but more rapidly. The drum and the roller are nearly, but not quite, in contact and the distance between them and their speeds can be adjusted to coat the drum with a uniform layer of a liquid or semi-liquid of any character. From the top of the outer cylinder, or case, a pipe leads to an exhauster by which air is drawn through the apparatus. This current of air, which enters freely at the open bottom of the case, comes into contact with a large surface of the liquid on the drum, keeps the temperature below the boiling point and so greatly accelerates evaporation that in many cases the liquid after making little more than half a revolution of the drum is converted into a dry powder. This powder is automatically scraped off by a knife placed near the bottom of the drum and falls on an endless band which conveys it to a suitable receptacle.

If it is desired to evaporate a very dilute solution to dryness it is advantageous to concentrate the liquid to

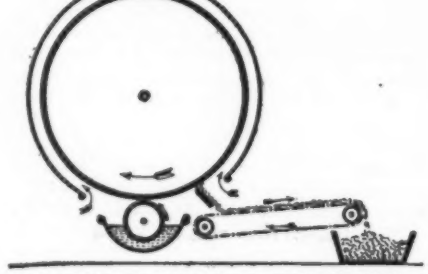
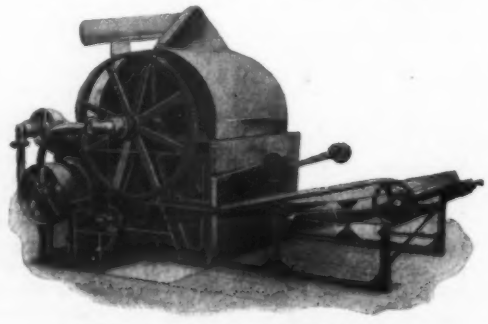


DIAGRAM OF NICOLAI EVAPORATOR.

a consistency of from 15 to 40 per cent of dry substance before passing it through the apparatus described above. This preliminary concentration is effected in a similar apparatus, based on the same principle, in which the drum and roller are replaced by a series of hollow lens-shaped vessels of sheet metal, mounted on a hollow shaft through which steam flows, and rotating half immersed in a trough. Air is drawn over the exposed upper halves of the rotating lenses. The film of liquid which covers them, thus concentrated by evaporation, is carried over and mixed with the thinner liquid in the trough and the operation is continued until the whole mass of liquid has attained the desired concentration.

Although the Nicolai apparatus is especially adapted for the evaporation of substances at low temperatures it may be used with advantage at temperatures above the boiling point for the rapid evaporation of substances not injured by heat. For this purpose the drum is supplied with steam at pressures up to 5 atmospheres, corresponding to a maximum temperature



THE NICOLAI EVAPORATOR.

of more than 300 deg. F. The rate of evaporation per square foot of drum surface increases rapidly with increase of temperature.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from Prometheus.

The annual Board of Trade return on railway accidents in the United Kingdom shows that 1,117 persons were killed and 8,811 injured by accidents due to the running of trains. These figures show a decrease of 52 in the number killed and an increase of 1,599 in the number injured, as compared with the totals for the previous year. Eighteen passengers were killed in train accidents, this number being below the average for the previous ten years. Eleven of these fatal accidents occurred in the disaster at Shrewsbury. The number of railway employees killed and injured in train accidents were 13 and 230 respectively; the number killed being the same as in the previous year, while the number injured shows an increase of 96. In the class of accidents caused by the movement of trains, exclusive of train accidents, 102 passengers were killed and 2,132 injured; a decrease of six in the number killed and an increase of 183 in the number injured, compared with 1906. It is remarked that the casualties to passengers in this class are much more numerous than those caused by train accidents, but they differ from the latter in this respect, that they mostly arise from the carelessness of the passengers themselves.

ELECTRIC WELDING OF COPPER.*

COPPER is a most difficult material to weld in the ordinary manner, hence it is not surprising that it causes trouble when employing electric welders.

Before entering into the practical data actually employed we may examine a few of the causes of the peculiarities of copper welding.

The chief physical properties of iron and copper to be compared in this connection are:

	Specific heat.	Conductivity.	Melting point.	Arcing Volts.
Iron	0.113	374	3,000 deg. F.	25
Copper ...	0.095	898	1,950 deg. F.	23

From these we might expect copper to be more easily welded than iron, since its melting point is so much lower and since its specific heat is less; but it is an actual fact that copper has to be raised to a very high temperature (as compared with iron) to effect a weld; an oxide is formed very readily, which oxide is not readily fluxed.

Unlike iron, copper has no pasty stage, but passes rapidly from solid to liquid, being, moreover, very brittle when approaching its melting point.

To effect a satisfactory weld in copper requires two to three times as much power as is needed for the same size of iron, but the time of application of the power is only about 0.6 that required for iron.

The data in the table below show the generator inputs, times of welding, etc., for various diameters of copper rods:

Diameter of rod. Inches.	H.P.	Seconds to weld.	Energy per weld (H.P.-seconds).
0.25	5	6	30
0.50	16.2	13	210
0.75	32.5	19	618
1.00	55	24	1,320
1.25	82.5	30	2,470
1.50	112	36	4,030
2.00	170	49	8,330

If welding rectangular sections, the power required is 25 to 50 per cent greater than for the equivalent circular section, and the time is 12 to 50 per cent greater. As further illustrating the effect of the material on the capacity of a welder: A machine which will weld a 2-inch diameter bar of iron or weldable steel will only weld a 1¼-inch diameter bar of brass, or a ⅞-inch diameter bar of copper.

The butting ends of the copper must be ground flat, and though the contact resistance of such butt joint may only be a few tenths of an ohm, yet it is the chief resistance in the secondary circuit of the transformer (and moreover increases with rising temperature),

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[* Practical Engineer.]

and in consequence the chief heating occurs at the joint as required. The superior conductivity of copper is another reason, beyond those already given, for the difficulty of welding the metal. A given current C will now produce only a fraction of the heating (equal to C^2R watts) which it would produce in a similar iron rod, R being greater in the latter case.

The mechanical pressure between the ends of the rods is an important point when welding; the pressure must be regulated to suit the size of rod and the plasticity of the metal when at welding temperature. Since excessive heating will permanently injure iron and steel (mechanically) it is necessary to use considerable pressure when welding them, but to keep the temperature well below the melting point. On the other hand, copper actually fuses for a moment at the weld, and hence the mechanical pressure required is much less. A great advantage of electric welding is that the heating is confined to a minimum of metal near the weld.

The arcing voltages of iron and copper are of interest, but in resistance welding (as opposed to arc welding) the formation of an arc must be prevented if possible.

In all cases, and particularly in the case of copper, owing to the ready formation of copper oxide, a weld should be completed at one operation, or the oxide formed will present great difficulty when trying to complete the process.

A properly made weld will show a slight uniform bulge at the joint, and this may be removed by filing or grinding, while a sand blast or wire brush will remove any adhering oxide.

Hammering the joint after cooling not only cleans it, by chipping off oxide, but also tests the mechanical properties of the weld.

ARTILLERY PRACTICE INDOORS.

TESTING FIELD PIECES IN ARMORIES.

BY DR. GEORGES VITOUX.

ARTILLERY practice usually presupposes the possession of very extensive practice grounds. It is difficult to imagine artillerists testing field pieces and siege guns in armory halls, but Lieut. Le Masne has invented an apparatus by the aid of which practical exercise in the essentials of gunnery can be obtained in rooms of moderate dimensions.

The object of the apparatus is to give an accurate representation of the conditions of actual warfare, when a battery is called upon to direct its fire upon a more or less distant, visible or concealed, post occupied by the enemy. In these circumstances the commander of the battery must determine as accurately as possible the distance of the point of attack, the instant of fire and the angle of elevation required to produce the maximum effect.

These conditions are met by Le Masne's apparatus in the following manner: A panoramic drawing of a landscape is made on a scale of 1 to 1,000, so that when viewed from a distance of 5 yards it will produce the same effect as the real scene produces when viewed from a distance of 5,000 yards from the nearest point of the foreground. This picture is placed in a vertical position and at short distances in front of it are placed four strips of small height on which are drawn, on proportional scales, the features of the nearer landscape at distances of 4,000, 3,000, 2,000, and 1,000 yards. The five pictures include all the points of attack on one side of the field.

Above the pictures several little cars are supported on a frame in such a manner that they can be moved up and down, to right and left, and forward and backward, the extent of each displacement being measured by a scale. These cars represent pieces of artillery and each is provided with a little ball which represents a projectile. The ball is attached to the car by a cord which is drawn up, bringing the ball close to the car, until it is released by pressing a spring, when the ball falls to a distance which is regulated for each case by the operator or "gunner."

The gunner stands behind the pictures and makes all the adjustments of the frame, cars, and cords according to orders given by the commandant, who stands 5 yards in front of the pictures. The cars and frame are concealed from the commandant by a curtain which may be lowered to any desired extent immediately in front of the apparatus. The pictures are sufficiently transparent to enable the gunner to locate indicated points from behind.

The officer, having chosen his point of attack, estimates its distance, decides on the arrangement of his battery and determines the angles of elevation and azimuth of each piece with reference to a point of the horizon, as seen in the large picture. He communicates these data to the gunner, who brings the battery (the frame of cars) to the height of the horizon point, regulates the length to which each cord shall be paid out and moves the cars forward, backward, and laterally according to directions, with the aid of the graduated scales. At the order "Fire!" the gunner releases the balls. If the commandant's estimates and calculations are correct and his orders have been followed exactly, each ball stops immediately above its point of attack, in one or another of the partial pictures. If the ball is found to be too far forward the shot has fallen short, if it is too far back the mark has been overshot. In either case the next shot can be corrected as in field practice.

But this is not all. In order to reproduce still more exactly the actual conditions of warfare, a device is added which enables the officer to attack a point concealed by a hill and revealed only by the momentary flashes of the enemy's guns. Behind the pictures is a row of keys each of which, when depressed, causes a rod surmounted by a little glass ball to rise for an instant and then vanish. The officer makes his instantaneous estimates of distance and direction with reference to these balls, which represent flashes of cannon.

The apparatus of Lieut. Le Manse is both simple and practical and enables valuable exercise in the art of gunnery to be obtained in the halls of barracks

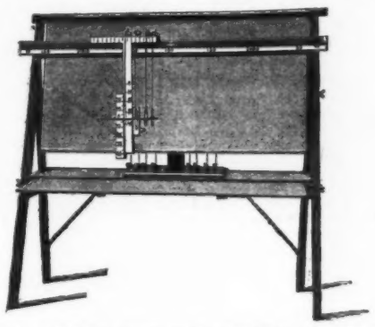


FIG. 1.—APPARATUS FOR INDOOR ARTILLERY PRACTICE. REAR VIEW.

and military schools, at practically no expense. This is a very important result, for field practice is necessarily greatly limited by the great cost of shells and powder and by various other difficulties. Of course the indoor method is designed only for supplement, or rather to precede field practice, not to supersede it. It has already been adopted by some artillery regiments and for the instruction of officers of the reserve corps and the territorial army and very successful experiments have been made with it by the artillery society of Paris.—La Nature.

LOW-PRESSURE STEAM TURBINE EFFICIENCY AND COST.

MR. CHARLES B. BURLEIGH presented a paper at the Saratoga Springs meeting of the National Association of Cotton Manufacturers, entitled "The Low-pressure Steam Turbine." The Electrical World publishes the following abstract:

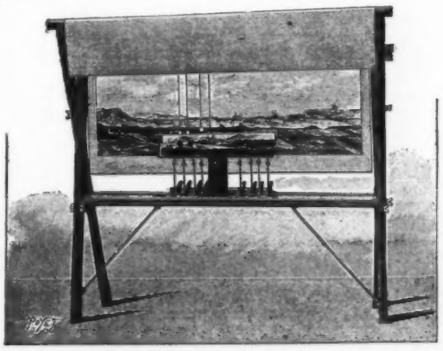


FIG. 2.—APPARATUS FOR INDOOR ARTILLERY PRACTICE. FRONT VIEW.

The author gave some interesting data concerning the performance of two 800-kilowatt Curtis turbines used in connection with reciprocating engines having a combined rating of 8,200 horse-power. The turbines receive steam from a common exhaust-main at a pressure of 1 pound per square inch above atmosphere, and exhaust into a condenser which maintains an average vacuum of 28 inches.

The coal consumption for all purposes at this station during the first six months of 1905, before the turbines were installed, averaged 4.48 pounds per kilowatt-hour. The coal consumption for all purposes for the first six months of 1906, after the turbines were installed, averaged 4.08 pounds per kilowatt-hour, showing a saving of 0.4 pound of coal per hour. As the total output of the station for the first six months of 1906 was 20,346,890 kilowatt-hours, there was a saving of 4,069 tons of coal, or 8,138 tons for the year, which, at an expenditure of $3 per ton, amounts to $24,414.

It is estimated that the original steam equipment cost $100 per kilowatt, and to have increased the equipment on the original lines would have required an investment proportionately equal to the original investment; the low-pressure turbines, with cooling towers, however, were installed at an expense of approximately $50 per kilowatt, and as the turbines are utilizing the energy in the steam previously unused, the fuel consumption has not been increased. In other words, considering a 1,500-kilowatt unit operating with one of the 800-kilowatt low-pressure turbines under the new arrangement, 2,300 kilowatts were made available at no more expense as regards fuel and attendance than was previously necessary to deliver 1,500 kilowatts to the distributing mains. As a matter of fact, the plant has actually delivered 19.5 per cent more energy with approximately 2 per cent less fuel.

Estimates were also given of the economy obtained with a 500-kilowatt low-pressure turbine in a railway generating station at Scranton, Pa., and an 800-kilowatt turbine at East St. Louis.

MAGNETIZED WELL TUBES.

THE fact that well tubes driven to great depths are more or less magnetized is familiar to all well borers. Ordinarily the magnetic strength is only sufficient to support tacks and the like but some well tubes become magnetized so strongly that they sustain screws, bolts, and large nails placed in contact with them. The tube of a well in Wheeling, W. Va., which has been examined by Prof. William Hallock is so strongly magnetized that it can support a crowbar. This tube is 4,500 feet long. Dr. Lane, State geologist of Michigan, asserts that the tube of a well at Grailing, in that State, became so strongly magnetized that it taxed the power of one man to haul up the steel measuring tape which, though 2,600 feet long, weighed only 25 pounds. A tape used in measuring the depth of a well at Sheboygan became so strongly magnetized and attracted by the tube that it could not be determined when the weight of 20 pounds, attached to the end of the tape, reached the bottom. As might be expected, compass needles are seriously affected in the vicinity of these magnetized well tubes. The well borers, however, are unanimous in asserting that the magnetism of the tubes gradually diminishes and often disappears entirely in a few years. The magnetization of driven well tubes appears to be only a fresh illustration of the well known law that elongated and nearly vertical objects of iron and steel are easily magnetized by the terrestrial magnetic field, if they are subjected to friction, blows, torsion, or other mechanical action. The direction of the terrestrial magnetic field in high latitudes is nearly vertical. At Paris the dipping needle makes an angle of 64 degrees with the horizon. If a piece of iron wire is vigorously twisted while it is held parallel to the dipping needle, or simply vertical, it will be found to be strongly magnetized.

Celluloid.—Twenty-five parts of ordinary celluloidin are dissolved in 250 parts of aceton and a solution of 50 parts of magnesium chloride in 150 parts of alcohol added until a paste is produced which occurs with a mixture proportion of about 100 parts of the first solution and 20 parts of the second solution. This paste is carefully mixed and worked, then dried and furnishes an absolutely non-combustible material.

THE WRIGHT AEROPLANE—ITS CONSTRUCTION.*

IT HAS FLOWN FOR OVER AN HOUR IN A 10-MILE BREEZE, HAS ATTAINED A HEIGHT OF 300 FEET, AND A SPEED OF OVER 40 MILES PER HOUR.

BY L. P. ALFORD.

The results of the aeroplane trials that were conducted from September 3 to 17, inclusive, by Orville Wright at Fort Myer, Virginia, in the presence of officers of the Signal Corps of the United States army, aroused great interest throughout the civilized world. They were surely epoch-making, and it is lamentable that they were brought to an end by disaster. A characterization of the machine as the greatest purely mechanical invention of this generation is none too strong.

* The text of this article is reprinted from the American Machinist and Western Electrician. The illustrations are republished from the Scientific American.

FIG. 1.—DETAIL FRONT VIEW OF CENTER OF AEROPLANE, SHOWING THE MOTOR, RADIATOR, GASOLINE TANK, AND SEAT.

The driving chain and sprocket of one propeller are visible at upper left-hand corner, and the crossed tubes carrying the other propeller chain can be seen on the right. The twin vertical rudder is also seen on the right at the rear.

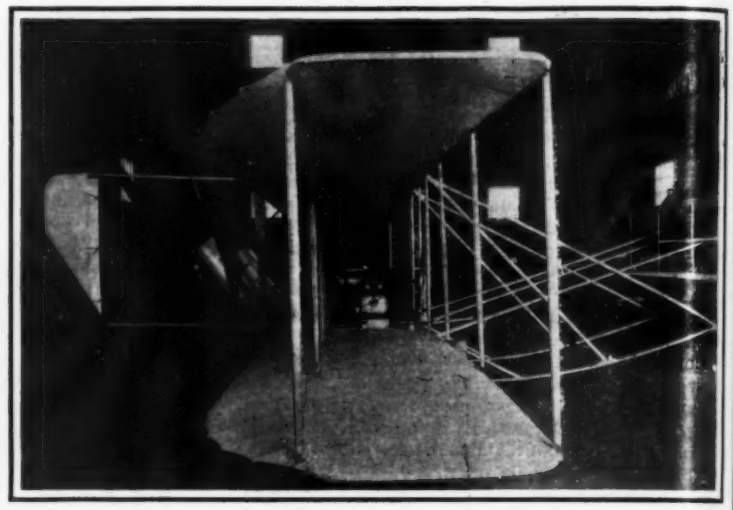


FIG. 2.—END VIEW OF AEROPLANE, SHOWING THE VERTICAL AND HORIZONTAL RUDDERS, PROPELLERS, GASOLINE TANK, MOTOR, AND RADIATOR.

This photograph gives a good idea of the slight curve of the planes as well as of their construction.

Copyright 1908 by Waldon Fawcett.

THE ARMY SPECIFICATIONS.

The machine was built to comply with a specification issued by the War Department for a heavier-than-air flying machine. A few of the more important provisions of this specification are: The construction of the flying machine must be such that it will be supported entirely by the dynamic reaction of the atmosphere and without any gas bag. It must be capable of being disassembled readily for transportation by army wagons. It must be capable of being assembled readily for flight in one hour. It must carry two passengers having a combined weight of 350 pounds, and a sufficient supply of fuel for a flight of 125 miles. Its speed in still air must be 40 miles per hour, and for that speed it will be paid for at the rate of 100 per cent of the tender price.

A 10 per cent reduction will be made for each mile less than the 40 miles per hour specified. However, any machine will be rejected that does not attain a speed of at least 36 miles per hour. Again a bonus of 10 per cent will be paid for each mile in excess of the specified 40 miles per hour. During the trials the machine must be continuously in the air for one hour without landing. It must return and land at the starting place and be ready for another flight at once. The machine must be capable of being steered in all directions and must be at all times under perfect control. The starting device must be of such a nature that it can be easily transported in army wagons. If at any time the propelling power is rendered inoperative, the machine must return to the ground without injury to itself or any of its mechanism. It must be capable of landing in any open country without having a special landing place prepared for it.

THE AEROPLANE.

The views here published show the Wright aeroplane. Its general outlines are well known. It consists of two long parallel planes that carry the machinery and operator. In front are two small horizontal rudder planes, and in the rear are two vertical rudder planes. It weighs complete about 850 pounds. The large planes are some 40 feet in length, 6½ feet wide and spaced about six feet apart. They are constructed of a light framework of white spruce, covered with a good quality of white muslin. The struts between the planes are of wood, and the truss-ing is by means of wire. The front of each plane is rigid, but the rear edge, although the cloth is stretched tightly over a wire passing through the ends of the ribs, is flexible and can be warped when the proper lever is moved. By means of this lever one end of both planes is thrown downward, and the other end is thrown upward, as shown in the diagram, Fig. 4.

ERNEST ZENS AND WILBUR WRIGHT. MR. ZENS WAS MR. WILBUR WRIGHT'S FIRST COMPANION.

MADAM HART O. BERG AND MR. WILBUR WRIGHT BEFORE THEIR FLIGHT IN MR. WRIGHT'S MACHINE

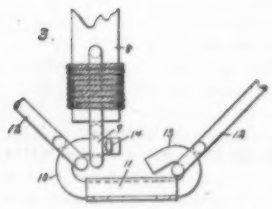


FIG. 3.—JOINT USED IN CONNECTING UPRIGHTS TO PLANES.

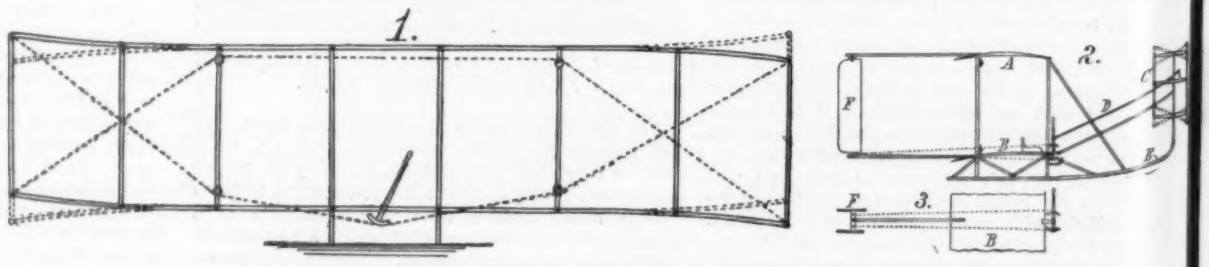


FIG. 4.—DIAGRAMS SHOWING HOW THE SURFACES ARE WARPED AND HOW THE RUDDERS ARE OPERATED.

1. Diagram showing connections for warping the planes. 2. Side view, showing connections, *D*, for operating horizontal rudder, *C*, which is carried on an upward projection of runners, *E*. 3. Plan view showing connections for operating vertical rudder, *F*.

This movement is made use of in balancing and in turning in the air.

The pair of small front-rudder planes, shown best by Figs. 4 and 6, are pivoted along a horizontal shaft that is supported and braced by the framework extending forward from the main planes. These rudder planes are spaced by wooden struts and are trussed together by means of wires. They are operated in unison by a long rod extending forward from one of the vertical operating levers. The small D-shaped

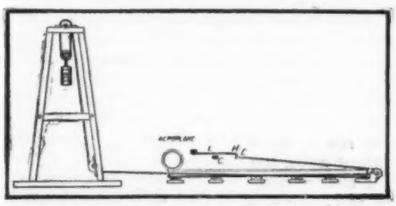


FIG. 11.—STARTING MECHANISM OF THE AEROPLANE.

vane between these two planes has a damping effect when the machine turns, or tends to turn, sidewise; in this way it adds to its stability.

At the rear is a twin vertical rudder, best shown in Figs. 2 and 4. Its method of support and attachment is plainly shown. An operating handle controls its motion about a vertical axis, and its use is to turn sidewise in flight. The entire machine is mounted on runners resembling sleigh runners, and best shown by Fig. 4.

The wood used throughout is clear white spruce, selected because of its lightness, strength and resilience. In finish the wooden parts are painted with aluminium paint; the cloth covering is left untouched and is, therefore, its natural white. The surface of the parts of the machinery is so small in proportion to the area of the planes that the general white effect of the entire machine is in no way disturbed.

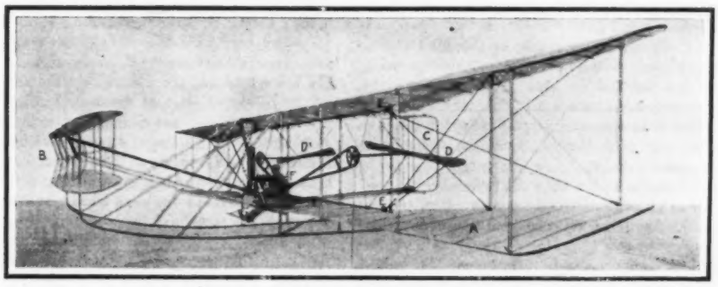


FIG. 12.—STEERING GEAR OF THE WRIGHT MACHINE. From Umschau.

A and *A'*. Main planes. *B*. Horizontal rudder. *C*. Vertical rudder. *D* and *D'*. Propellers. *E*. Plane warping cable. *F*. Motor.

THE PROPELLING MECHANISM.

The propelling and transmission machinery is shown by Fig. 1. The propellers themselves can be best seen in Fig. 8. The engine is a four-cylinder four-cycle gasoline engine, designed and built by the Wright brothers. It weighs 170 pounds and develops from 25 to 30 horse-power. It is fitted with make-and-break igniters, the current for which is supplied by a magneto. It also has automatic inlet valves and a special direct-feed arrangement for supplying the fuel, which is pumped to the inlet valves, thus dispensing with a carbureter. A large fuel tank is placed beside the engine. A four-section radiator occupies the entire height between the two main planes. This is composed of flattened brass tubing, connected into suitable headers at top and bottom.

FIG. 5.—FRONT VIEW OF LOWER PLANE.

The radiator, motor, fuel tank, seat, and levers are visible. The aviator sits farthest from the motor and holds the horizontal-rudder lever in his left hand and the vertical-rudder and wing-warping levers in his right. Note foot-rest in front of levers.

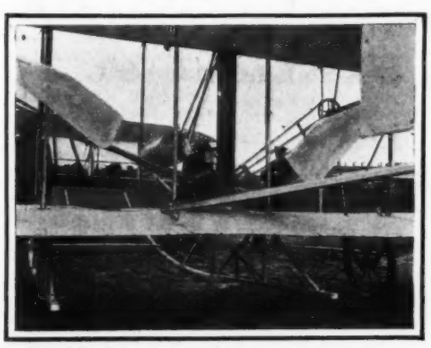


FIG. 7.—REAR VIEW, SHOWING MOTOR, PROPELLERS, AND DRIVING CHAINS.

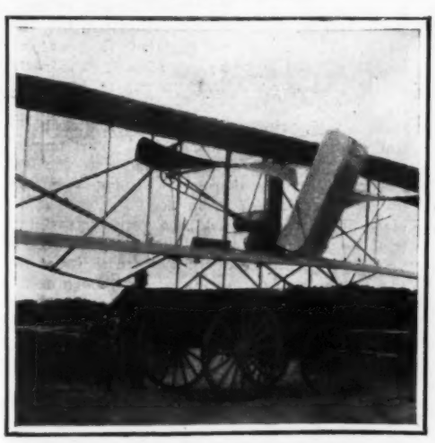


FIG. 8.—THE AEROPLANE ON AN ARMY WAGON.

The runners are folded back against the front edges of the planes and the rudder is placed against their rear edges.

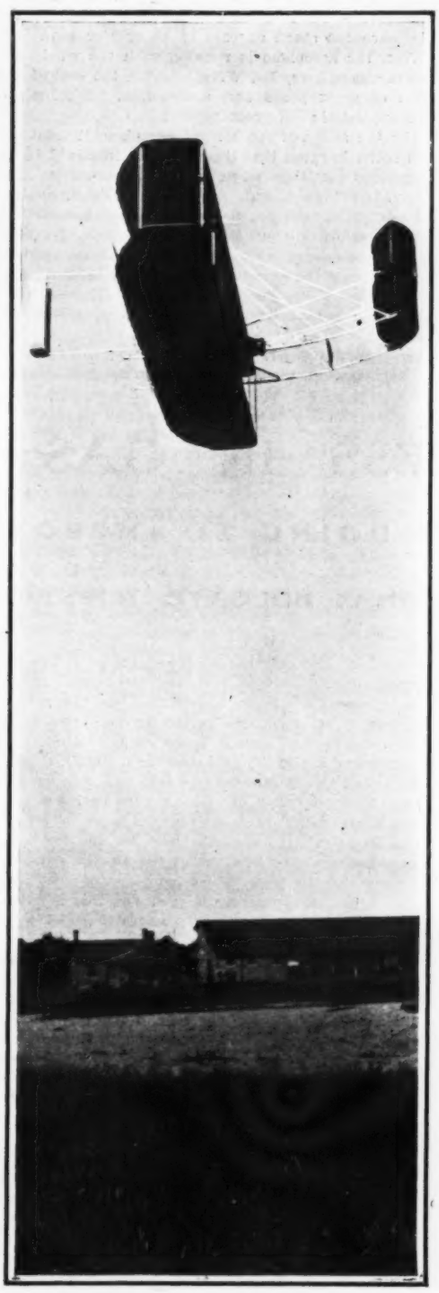


FIG. 9.—THE AEROPLANE FLYING AT A GREAT HEIGHT.

In some of its flights the machine is estimated to have reached an elevation of 300 feet.

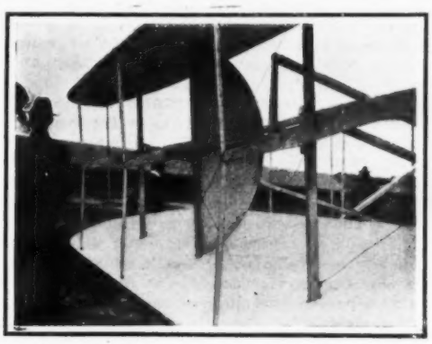


FIG. 6.—DETAIL VIEW OF FRONT HORIZONTAL RUDDER.

In this photograph the rudder is shown tipped downward. The operating lever and wood rod connecting to lever on aeroplane are visible. Also note semi-circular vertical surface which is loosely mounted at the center.

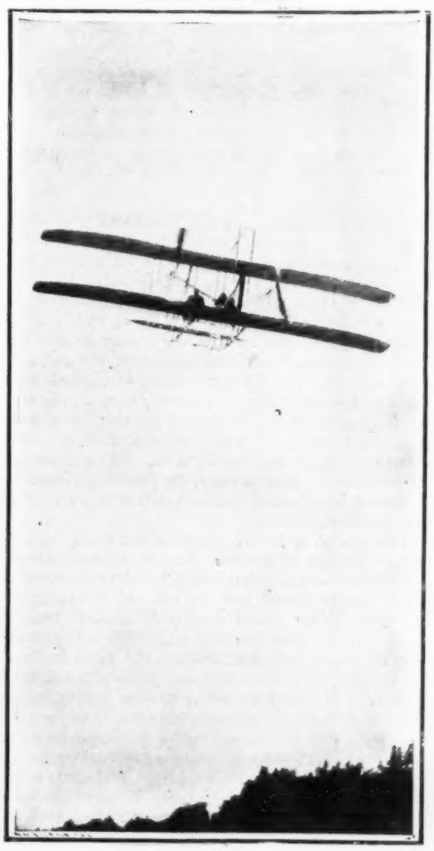


FIG. 10.—REAR VIEW OF THE AEROPLANE MAKING A TURN.

The machine can make a much sharper turn than this, and in so doing dips downward much more.

The power is transmitted from the engine shaft to the propeller shafts by means of automobile chains. The ratio of speed reduction is 9 to 32. At this point is one of the most interesting mechanical devices of the entire machine—the crossed chain connecting the right-hand propeller with the engine. The chain is carried through guide tubes and we are informed works with perfect success.

The propellers are 8½ feet in diameter. The ends of the blades are square, one side of the blade being beveled off. The propellers revolve in opposite directions. They are carried on long shafts supported by metal braces, and these braces are practically the only metal braces used in the construction of the aeroplane. The speed of these propellers is from 350 to 400 revolutions per minute.

CONTROL OF THE MACHINE.

Three operating handles can be seen in front of the seat in Fig. 5. The seat is arranged to accommodate two persons. The operator sits at the right, or farthest from the engine. In that position his weight practically balances the weight of the engine. The second person sits on the midline of the machine and therefore automatically preserves the balance, whatever his weight may be.

Of the three operating levers, the one at the right of the illustration is connected with the front pair of rudder planes. These planes are used in controlling the vertical movements of the aeroplane. Of the other two handles, the one nearer the engine controls the swinging of the vertical rear rudders and its mate the twisting of the ends of the main planes. These two levers are placed back to back, as they are ordinarily worked together; although it is perfectly possible to separate them and work them independently, as indicated by the position that they occupy in the illustration.

STARTING THE AEROPLANE.

Only a short explanation is necessary to give the reader a clear idea of how the machine mounts into the air. Briefly, the aeroplane is practically shot obliquely into the air by the action of a heavy falling weight. Reference to Fig. 11 will show diagrammatically a single-rail track laid on the grass on blocks. At one end of this runway is a four-post tower, looking very much like an oil derrick. Suspended on a system of pulleys connected with a five-eighths-inch hemp rope is a weight of several hundred pounds. This weight is pulled up into the air for, say, 10 feet, and the rope from it runs out alongside this single track to its end, where it passes over a six-inch iron grooved pulley and back to the bottom of the aeroplane framework. This rope is attached to the aeroplane by a sort of trigger *L*. This trigger is so constructed that when the aeroplane, pulled by the jerk of the falling weight, reaches the end of the runway, the trigger releases the rope from the aeroplane and leaves it free to mount into the air. The weight by this time has about reached the ground.

As shown in Fig. 11, the eye *E* of the rope is attached to the horizontal swinging lever *L* of the aeroplane by the hook *H*. As the aeroplane shoots over the monorail, the eye *E* drops from the hook, and the lever *L* falls into a safe position on a crossbar *C*, which is also a part of the aeroplane.

In starting the aeroplane, the aviator mounts his seat and gives the word to start. The weight is allowed suddenly to drop. The aeroplane resting on a sort of single-wheel truck and balanced by a man at each side, shoots forward until at the end of the track it has attained, roughly speaking, about a 20-mile speed. Now by a slight manipulation of the lever to his left the aviator elevates the nose, so to speak, of the aeroplane (viz., front horizontal rudder) and the machine instantly leaves the track, and mounts in a most graceful manner into the air, thereafter forced ahead by propellers.

According to Mr. Wright, one of the chief sensations at starting is a realization of the great noise of the motor, and the seeming rush of the ground backward beneath him. Once in the air, the higher the aeroplane mounts the slower it seems to go. When at quite a distance from the ground, although really going at the same high speed, the motion seems to the aviator to be "slowing up," except in cases where the machine is running directly into the wind. In this instance the speed appears to be greater than it is. When the aeroplane is running with the wind or in calm atmosphere, Mr. Wright states, the sensation is one of great peace and satisfaction, with little or no appreciation of great speed.

In the study of the Wright aeroplane it must first be borne in mind that the weight is sustained by the reactions resulting, when one or more aeroplanes are moved through the air edgewise at a small angle of incidence, either by the application of mechanical power or by the utilization of the force of gravity. In the aeroplane are provided means for maintaining or restoring the equilibrium or lateral balance of the apparatus, means for guiding the machine both vertically and horizontally, and at the same time the structure must combine lightness, strength, and convenience of construction.

In flying machines of this character the apparatus is supported in the air by reason of the contact between the air and the under surface of one or more aeroplanes, the contact surface being presented at a small angle of incidence to the air. The relative movements of the air and aeroplane may be derived from the motion of the air in the form of wind blowing in the direction opposite to that in which the apparatus is traveling; or by a combined downward and forward movement of the machine, as in starting from an elevated position; or by combination of these two things; and in either case the operation is that of a soaring machine, while power applied to the machine to propel it positively forward will cause the air to support the machine in a similar manner. In either case, owing to the varying conditions to be met, there are numerous disturbing forces which tend to shift the machine from the position which it should occupy to obtain the desired results.

The chief object of the design of this aeroplane is a means for remedying this difficulty.

Now, without going into a detailed description of a delicate yet simple method of construction, whereby the planes at their outside ends may be warped or twisted (a matter which the designers do not wish to explain in detail) it may be stated that by this means it is possible by a single movement of one lever at the right of the aviator's seat to move up or down the back edge or corner of the lateral edges of the aeroplane. They may be warped, at will, on one side of the machine either above or below the normal planes of the aeroplanes, a reverse movement of the similar corners on the other side of the machine occurring simultaneously.

During this operation each aeroplane is practically twisted or distorted around a line extending centrally across the same from about the middle of one lateral margin to the middle of the other lateral margin, the twist due to the moving of the lateral margins to different angles extending inward toward the central portion, from side to side, so that each aeroplane surface is given almost a helicoidal warp or twist. This construction and mode of operation gives a gradually increasing angle to the body of each aeroplane from the central longitudinal line outward to the margin, thus giving a continuous surface on each side of the machine, which has a gradually increasing or decreasing angle of incidence from the center portion of the machine. Any construction whereby the angular relations of the lateral margins or portions of the aeroplanes may be varied in opposite directions with respect to the normal planes of the aeroplanes, comes within the scope of the designer's idea.

RECENT PROGRESS IN GAS MANUFACTURE.

WHAT EUROPE IS DOING TO IMPROVE GAS LIGHTING.

BY THOMAS HOLGATE, M.INST.C.E., F.C.S.

THE annual meeting of the Institution of Gas Engineers lately concluded has synchronized with that of their German *confrères*, and has been marked by an interchange of information that is likely to be productive of much good to the industry concerned. At the termination of their own meeting eighty British gas engineers were received in Berlin as guests of their professional brethren, mainly for the purpose of inspecting the various installations of vertical retorts used in the manufacture of gas for that city, and also for seeing the admirable street lighting by means of inverted burners. The particular type of vertical retorts used there and elsewhere on the Continent, but not as yet in this country, is the invention of Dr. Bueb, of Dessau, and usually referred to as the "Dessau" system.

Essentially it is the time-honored retort, set vertically instead of horizontally, but worked somewhat differently. That difference is found in the fact that the vertical retorts are worked full of coal, while horizontals are almost invariably worked less than half full. It is obvious that when once this procedure is proved advantageous, it ought not to be impossible to apply it to horizontals; and, indeed, this is in certain British gas works being more or less approached, and machines are already installed that can effect the operation the moment such a course is desired. At the present time it would appear that the rapid spread on the Continent of the Dessau system is due to side issues, rather than to an incontestable increase of light-giving constituents from the coal. In saying this, however, it must be made clear that these side issues are of considerable importance. The advantages that appear to be beyond doubt are: 1. The reduction in the naphthalene formed. 2. The reduction in the quantity of the organic sulphur compounds formed. 3. The superiority of the tar produced. 4. The increase in the quantity of ammonia produced. It is true that the last-named increase quite naturally causes a reduction in the yield of cyanogen, but inasmuch as the market price of this substance tends toward a continuous decline, the removal of a quantity may tend to maintain a higher price, and in any case may be regarded with equanimity. The possibility of making pure coal gas or an admixture with water gas, in the same retort, and the reduction of distressing heat for the fewer men employed are also in favor of the Dessau system.

According to Herr Weiss, engineer of the Zurich gas works, the number of men required for hand-stoked horizontals, inclines, and verticals is in the ratio 28, 7, 2 respectively.

From these general statements it is quite evident that there is justification for the rapid adoption of the systems, provided that there is no falling off in the values of the gas and coke produced, and about these there appears to be no reason for anxiety.

The tests made by representatives of the two associations of gas engineers, and by others—with one exception—indicate that where pure coal gas is made there is no falling off in the heating or lighting value obtained in the gas from one ton of coal.

Thanks to the labors of Mr. J. F. Bell, of Derby, and other British gas engineers, the naphthalene difficulty, in horizontal retort working, has been overcome by washing the gas with suitable tar or petroleum oils in separate washers or scrubbers. As this involves some little capital expenditure, the Dessau system is entitled to the small saving in working and capital charges which attaches to "prevention being better than cure."

Similarly, in the more urgent matter of organic sulphur, the same adage has secured a welcome exemplification.

Having thus briefly referred to a method which has been recently described by Mr. Hayman, of the Imperial Continental Gas Association, Berlin, as the one which, by its extensive adoption, is shown to be proof against all competitors, it must now be mentioned that there are friendly rivals undergoing experimental and commercial evolution in Great Britain.

The first vertical retort installation was that of Mr. Andrew Scott, of Musselburgh, and that was followed by the general adoption of the vertical form in the distillation of shale in the lowlands of Scotland. Meanwhile at Rheims was introduced the inclined retort, which set at an angle of 30 deg. has been largely adopted at home and abroad. The revival of the idea of the "vertical" is due to Mr. Settle, of Exeter, who combined therewith the idea of a continuous feed, previously tried on a rotated horizontal iron retort. He adopted a vertical retort terminating in an inclined shoe or base to facilitate the frequent discharge of coke therefrom without requiring the use of a water seal as in Scott's retort. Unfortunately, Mr. Settle has not been very successful in his trial installations, but the soundness of the general principles has been largely accepted in Great Britain, and other systems having a continuous feed have been or are being tried at (1) Bournemouth, London (Nine Elms), and Liverpool; (2) Guildford; while shortly another type is to be tested at St. Helen's.

The method employed by Mr. G. R. Love at Guildford is a retort set at an angle of 45 deg., and worked full. The charging in the first trials was continuous, but now is intermittent, as with the Dessau, and the results in the main are confirmatory thereof. At St. Helen's the engineer, Mr. Samuel Glover, has erected a setting of vertical retorts in which continuous charging and discharging will take place, and which system may be taken as embodying the ideas

of himself and the late Mr. William Young, of Peebles, the experienced shale-oil technologist. The working results are likely to be available during the coming winter and are awaited with much interest. Meanwhile attention is concentrated upon the Woodall-Duckham system as developed since 1904 at the Bourne Valley and Poole works of the Bournemouth Gas and Water Company. The historical account given at the recent meeting of gas engineers, by Mr. H. W. Woodall, has enabled the writer to compile the subjoined table and thus subject the results to a comparison with those of the Dessau, and both relatively to ordinary practice. The varying methods of using the Dessau as to the amount of steam admitted, and the varied types of Bournemouth herein included, make a perfect comparison impossible.

Name of Gas Works or System.	Date of Test.	Cubic Feet of Gas per Ton of Coal.	Gross Heating Power.	Lighting Power per Five Cubic Feet.	British Thermal Units in the Gas from One Ton of Coal.	Lighting Value in Candles per Ton of Coal	Steam Used.	Line No.
Poole	1908	14,165	551	14.26	7,804,915	40,398	Evaporated eight gallons of water per ton coal.	1
Dessau	1908	11,259	604	16.45	6,800,436	37,050	None.	2
Differences	....	2,906	...	....	1,004,479	3,342		
Bourne Valley	1905	18,403	513	12.04	9,440,739	44,314	Continuous evaporation.	3
Dessau	1908	14,650	558	12.90	8,174,700	37,797	Two hours out of eleven hours.	4
Differences	....	3,753	...	....	1,266,039	6,517		
Bournemouth	1905 to 1908	5,434	553.5	13.70	8,302,405	41,564	Average of one test at Nine Elms and four at Bournemouth.	5
Dessau	1907	14,084	552.5	11.08 (?)	7,782,924	31,370 (?)	Ditto of the five best in heating value.	6
Dessau	to 1908	12,752 Estimat'd	576.3	14.83	7,325,406	37,520	Ditto of the five best in lighting value.	7
Ordinary retorts—London	1907	11,000	586.0	16.09	6,485,000	35,308	No steam used.	8

Lines 1 and 2 compare the continuous and the intermittent systems, when the steam entering the Poole retort was at a minimum, and that into the Dessau was *nil*. Lines 3 and 4 continue the comparison when the highest calorific results were attained, without restriction as to steam admission. Line 8, normal working of a London company making coal gas only (see Times Engineering Supplement, page 146, of May 8, 1907). Line 5 gives the average of five tests, with somewhat incomplete data. Line 6 gives the average of five tests selected out of eleven, taking the highest in calorific results. Line 7 is as line 6, but the selection made is the highest in illuminating results.

It would seem from these figures that the continuous system is the one which yields the greatest product of heating and lighting values. The coals used would not be identical, but the differences are so striking that one is compelled to adopt the opinion expressed until rebutting evidence is available. Still it must not be overlooked that in these comparisons the heating and lighting powers per cubic foot are, on the whole, in favor of the intermittent system, and a final judgment must be withheld until the precise value of each factor that makes up the product has received further elucidation. This is especially necessary in view of the fact that the light from an incandescent mantle increases very rapidly as the flame temperature increases, which is usually coincident with the higher calorific power.

The Dessau system provides a ready means of increasing the heating results, but this is always at the expense of the lighting, and it scores in the above comparison, because it is only quite recently that the amount of steam entering the Bournemouth system has been brought to small dimensions.

The effect of adding steam to the Dessau retort is seen at a glance in the following table, which shows the decrease in lighting and increase in heating results, per cent, when various proportions of steam are added:

	Percentages. Decrease in Lighting.	Increase in Heating.
Dessau, using Boldon coal	10.0	0.7
Dessau, using New Pelton coal.	3.1	2.4
Zürich, using Saar coal	22.4	7.7
Mariendorf, using Silesian coal	7.3	11.2
Average of the four tests..	10.7	5.5

Thus, while the product of the quantity of gas into the illuminating power as determined by the No. 2 Metropolitan burner, or into the calorific power, provide valuable criteria of efficiency, they must not be slavishly followed. So far as lighting questions are concerned, they must be regarded as provisional only, requiring to be supplemented by a factor drawn from the lighting value when the gas is used for incandescent lighting. Evidence of this is forthcoming from Edinburgh, where the gas engineer, Mr. W. R. Herring, M.Inst.C.E., using the rich gas of that city under a pressure of 55 inches in an inverted burner, obtained 73.6 candles per cubic foot, when the air and gas were preheated. Upon the authority of Prof. William Hallock, of New York, we are informed that, with a still richer hydrocarbon gas, of 1,724 British thermal units per cubic foot, the illuminating power was 120 candles per cubic foot. The recent lecture of Prof. Bone showed that the vigor of combination between hydrocarbons and oxygen was so great as to take precedence before that of hydrogen. It is clear, therefore, that the development of gas manufacture must still take cognizance of hydrocarbons, and it cannot be said that water gas alone meets the highest possibilities of the case.

Closely akin to this question is the amount of variation in the quality of gas distributed to consumers. In an article published in May, last year, the present writer gave details of the extent to which this variation existed in the case of the three London companies, and from those figures showed that with coal gas alone the variation was from 658 to 526 British thermal units (gross), or a range of 132, for a mean of 592, equal to 22.3 per cent. According to Mr. Hayman, in Berlin it has been customary, in the district of the Imperial Continental Gas Association, to have a variation from 620 British thermal units to 560 British thermal units (gross), or a range of 60, for a mean of 590, equal to 10.2 per cent; but by using vertical retorts that variation has now been brought to 10 British thermal units—viz., 560 to 550 (gross), or 1.8 per cent. In the words of Mr. Hayman at the London meeting, which are almost identical with those used at the same time by his chief in Berlin: "What is it that the consumer wants having regard to the present development of gas lighting? He requires for his sensitive inverted burner a gas of unvarying calorific power, specific gravity, and pressure. At Mariendorf and Oberspree, by means of strict supervision, we have succeeded in maintaining the uniformity of the gas in a remarkable degree. . . . To produce gas of this description the vertical furnace is the best and most economical in the field."

This recognition of a valuable principle is highly to be commended, although it is not clearly stated from whence the uniformity springs. However, one fact is obvious—that if, by strict supervision, the intermittent operation will yield a uniform gas, much more ought the continuously operated be expected to succeed. That view is confirmed by five days' tests at Poole, the illuminating power being 14.5 maximum, 14.2 mean, and 14 minimum standard candles respectively; and the calorific power being similarly 566, 551, and 546 British thermal units (gross).

These remarkably good figures of 3½ per cent range, in both lighting and heating, were from a single retort, and would naturally be better still when a number were in operation.

In view of the recent decision of the London County Council to investigate the action of the sulphur present in London gas, and also the complaints of some of the other Metropolitan boroughs as to the same, it is instructive to know that the vertical retort secures a reduction in the quantity produced, as shown by the following figures, compiled from authentic sources:

Gas Works.	Class of Retort.	Coal Used.	Grains of Sulphur per 100 Cubic Feet of Gas.
London	Ordinary	Durham	84.1 maximum
London	Ordinary	Durham	47.9 average
London	Ordinary	Durham	21.7 minimum
Cologne	Ordinary	Westphalian	30.59
Cologne	Dessau	Westphalian	17.35
Oberspree	Dessau	Lambton	12.00
Dessau	Dessau	New Pelton	21.70

Altogether the prospects of advance in the gas industry are bright, and with the further co-operation of gas engineers on both sides of the Channel great things may be expected with confidence. Progress will be very much facilitated when all the results are stated on a common basis, and toward this end the No. 2 Metropolitan testing burner has been a great step. The advantages of this burner for research purposes are being appreciated on the Continent, and if the gross and net calorific power of the gas be in all cases stated, as well as all volumes recorded at 15 deg. C. and 760 millimeters pressure, or 60 deg. F. and 30 inches pressure, then a more ready comparison of results will be possible than hitherto.—Engineering.

BRAZING CAST IRON AND OTHER METALS.

By FRANK N. BLAKE.

BRAZING consists in uniting metal parts by flowing melted brass, technically termed spelter, between them. It is practically identical with soldering, except that spelter is substituted for solder, and that a much greater degree of heat is necessary. In the greater degree of heat required to melt spelter lies one of the advantages which brazed work possesses over that which is soldered, the finished work enduring more heat without breaking or weakening; but the chief advantage lies in its superior strength at all temperatures and its applicability to a large variety of uses. Cast iron is a common material which is prone to break, and which can now be brazed. The production of the necessary heat is an important part of the process of brazing, and constitutes the chief difficulty and almost the only source of expense. For small work, a plumber's hand gasoline torch can be used in what may be termed an amateur sort of way, but for common use a forge, gasoline brazer, or a jet of gas supplemented by a blast of air can be satisfactorily used. The latter constitutes the cleanest, most convenient, and effectual brazing fire.

A bed of coke or charcoal on a forge hearth is an excellent resting place for the work during the process of brazing. A backing of firebrick or of asbestos is of considerable assistance in confining and reflecting the heat, though, of course, these do not contribute to the heating process in the way that inflammable backings do. There is considerable opportunity for the display of judgment and discretion in the arrangement of the backing; aside from the saving of time and fuel there is, on large and difficult work, all the difference between success and failure in the way the heat is applied and utilized.

Before work is assembled for brazing it should be well cleaned by file, scraper, scratch brush, or other means; rust and scale do not favor the ready flowing of the fused spelter, though it will sometimes take hold of even such unfavorable surfaces. Cast iron may be cleaned by first heating to a bright red, and, after cooling, brushing the fracture and adjacent parts with a scratch brush. After thoroughly cleaning the work and securing good bright surfaces, the parts must be fastened together in the exact position they are to occupy when the job is completed. Usually the pieces are secured by pinning, but sometimes screws, bolts, wire, clamps of various sorts, and even fire-clay can be used to hold the parts in place. Whenever practicable, the parts should be secured in such a manner that the job can be turned over during the process of brazing, without disturbing the relation of the parts to each other, thus affording a better chance to apply the flux and spelter.

Alcohol used in a common gasoline torch has been said to give a greater heat than gasoline, the reason given being that it requires less air, and consequently the flame is cooled less by it. As alcohol contains fewer heat units than gasoline, it would seem a less suitable fuel to use for this purpose, but perhaps the need of less air may explain the difference claimed for it.

A simple and good formula for cast iron brazing is as follows:

	Ounces.
Boric acid	16
Chlorate of potash, pulverized	4
Carbonate of iron	3

Mix and keep dry, as moisture or long exposure to air renders it less efficient. When used, mix with grain spelter. Heat the work to a nice brazing heat and apply flux and spelter with an iron rod, flattened and spoon shaped at the end.

Borax is much used for flux in brazing wrought iron and steel; it is not expensive, and one can be sure of getting a good article by buying of a reputable dealer. In any brazing, the work is first brought to a bright red heat, flux is applied, and then mixed flux and spelter. Sometimes considerable "coaxing" is required in order to make the melted metal flow into the joints; but with the flux applied first and allowed to find its way into the cracks and openings, the spelter will follow if carefully led and rubbed with the hot iron rod. After one side of the work has been brazed, it is turned over and the other side is treated in the same manner.

In preparing work for brazing, too close a fit may be made, for the melted brass will not find its way into the most minute recesses. One one-thousandth of an inch is about as small a space as spelter will readily flow into.

After brazing cast iron, it is a good plan to let it cool slowly, sudden chilling being regarded as injurious in some cases. Whatever process is employed it is a good rule to have the work bright and clean, and to use plenty of heat; these, together with good flux and spelter, constitute the essentials. Experience is always valuable, but that comes only with practice.—Horseless Age.

THE CHAMELEON IN CAPTIVITY.

THE STRANGEST OF PET ANIMALS.

BY F. MARTIN-DUNCAN.

Of all the various species of reptiles that are kept as pets, the chameleon is probably the most interesting—certainly the most bizarre in appearance. Unfortunately, they are very susceptible to cold, and, therefore, difficult to keep through the ever-varying climatic conditions of a northern winter. Nevertheless, so quaint, interesting, and amusing a pet is the

THE MOST BIZARRE OF ANIMALS.

chameleon, that it will well repay one for all the trouble or care lavished upon it. Certainly the most successful method of keeping chameleons would be to let them have the run of a small conservatory, kept at an even temperature of about 65 deg. to 70 deg. Fahr., and in which there were a few dwarf trees for them to climb about. A cheap and successful method, where a conservatory is out of the question, is to have a wooden cage, with a glass front and sides, and a shallow water-tank floor. The water in the tank can quite easily be kept at an even temperature by means of a spirit-lamp placed beneath it. In such cages the author has kept chameleons and boa constrictors most successfully, and at a very small cost. Once the desired temperature is indicated on the thermometer, the flame of the spirit-lamp can be reduced to a very small size, and the cost of spirit consumed will only amount to a few cents per week.

Popular imagination has assigned to the chameleon the power of changing through all the colors of the rainbow, but its actual performance falls short of this, some colors being quite beyond its powers. However, the chameleon is something of a "quick-change artist," and can pass through a series of yellows, grays, greens, browns, to almost black; moreover, it can accomplish that feat which is beyond the power of the leopard, for it can, and does, change the color of its spots. The main factors that cause the rapid changes of color are anger, excitement, fear, warmth, cold, and death. In the full blaze of the summer sun the chameleon assumes a blackish hue, with pale, pinkish yellow spots and ventral stripe.

What a quaint, archaic appearance the chameleon presents, more like the creation of some monkish sculptor, a stone "devil of Notre Dame" come to life, or some survivor from a past geological age. The toes, in their arrangement of three on one side and two on the other of each hand and foot, are singularly suggestive of a bird, as is also the manner in which they grasp the bough upon which the chameleon is resting or climbing. The constantly-changing facial expressions are very quaint and laughable. There is always a look of sardonic humor lurking round the lines of the mouth and it is greatly increased by the weird effects produced by the independently-moving eyes; indeed, the little reptile is a champion squinter. Anatomically, there are at least two most interesting points about the chameleon. First, it is unique among limbed reptiles as the possessor of a prehensile tail; and, secondly, for the peculiar blind outgrowths of the lungs, which, spreading through the body, literally enable the animal to "swell visibly."

Generally speaking, the body of the chameleon presents a very lean and emaciated appearance, and can, by the contraction of the muscles lying between the ribs, become still more attenuated. This contraction generally takes place on the chameleon observing the approach of a foe, and is accompanied by a change of color to a tint closely resembling that of its surroundings, making it practically impossible to detect the whereabouts of the reptile. For its size the chameleon has a very hot and ungovernable temper, and if disturbed and provoked will swell out its body, hiss, make violent snaps with its jaws, and change from one color to another with great rapidity. By this sudden and extraordinary display of wrath it very easily startles and puts to flight its smaller, unwelcome visitors.

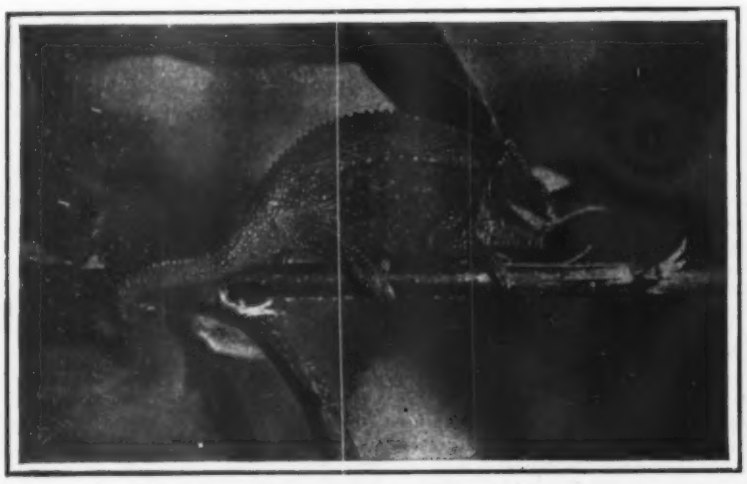
To watch a chameleon feeding is really a wonderful and most interesting sight. The chameleon, resting absolutely motionless upon a bough, except for the independent rolling of its eyes, watches until an insect comes within the length of about its body and tail, then suddenly the long, fleshy, cylindrical tongue, with its curious lobed, cup-shaped end, is shot out, and the victim is stuck fast to it by a viscid secretion and drawn into the hungry mouth. If in a healthy condition the chameleon thoroughly enjoys a tepid spray bath, administered by the aid of a garden syringe. The water used should never be quite cold, but with just the chill off. It also likes to lick the water off the leaves of the bush or shrub upon which it has taken up its abode. Although not exactly of an affectionate disposition, it soon learns to recognize its master or mistress, and on seeing him will climb along the bough in expectation of a feast of meal-worms. Altogether, the chameleon makes a most charming and interesting pet, requiring but little attention beyond a daily supply of live meal-worms, and a cage kept at a regular and even temperature.—Country Life (London).

The Anglo-Saxon race is prone to peculiarities and eccentricities of diet, according to The British Medical Journal. At a dinner-table it is interesting . . . to watch one's fellow guests and note what they take and what they decline, and the most striking results are obtained by observing a party of English men and women at the *table d'hôte* in a foreign land. One section abhors omelets, another is equally emphatic in refusing Italian pastes, macaroni, and the like, while others declare that the sight of oil-dressed salad inspires nausea. Some take cheese and fruit, others do not. But the noteworthy feature in this pick-and-choose dietary is the solemnity with which the idiosyncrasy is asserted, with an accent of sincerity which betokens the consciousness of merit. It is not merely a question of disliking this or that article of food, the

THE CHAMELEON ALERT.

tone is such as to cast aspersions on all who think otherwise. If, by way of contrast, we watch foreigners at dinner we shall be struck by the fact that while they may vary as to quantity, old and young alike partake of the dishes in due sequence. Why is it that the English stomach in general shows such antipathy to olive oil, which is the ordinary culinary fat in so many parts of the world? How is it that the Englishman, who revels in such light delicacies as roly-poly pudding, fights shy of *nouilles* and vermicelli? One explanation may be that children in many families are allowed to pick and choose, or, at any rate, to express approval or dislike, a license which bears pernicious fruit in later life. It may be added that in no country is the culinary field as limited as in England. In France they make use of numerous vegetables and foodstuffs unknown across the Channel.

Geletinized Benzine.—If we dissolve 120 parts of white soap in 180 parts of hot water, add 30 parts of concentrated ammonia to the solution, make up this solution with water to 750 parts and then make up to 1,000 parts with benzine, we obtain a gelatinized mixture. Of this, 1 teaspoonful, mixed while being shaken with 280 parts of benzine, produces the gelatine recommended for removing spots. It cannot be denied that this mixture contains everything commendable for the cleansing of spots from fabrics. It contains soap, spirits of sal ammoniac, and benzine. Its advantages consist in the benzine being, in this form, less volatile, consequently not so inflammable, that it is in consequence better to handle and that it furnishes a preparation that can easily be introduced in this form.



BEARDED SOUTH AFRICAN SPECIES.

A CHAMELEON IN ANGRY HUES.

THE MIRACULOUS EDESSA.

A SIXTH CENTURY PARCHMENT RECENTLY DISCOVERED IN EGYPT.

M. FR. TALON, in a little work entitled "The Marvelous Story of the Traditional Portrait of Jesus," gives the following version of a tradition which dates from the time of the apostles:

"A petty king named Avagair reigned at Edessa, a city in Armenia, beyond the Euphrates. This ruler to whom the Greek and Roman historians give the names of Abgar, Agbar, Abagar, and Augar, and the title of toparch, sent an embassy to Marinus, the Roman governor of Phœnicia, Palestine, Syria, and Mesopotamia. On their journey the ambassadors heard of Jesus and the miracles performed by him, and at last they saw him and witnessed his healing of diseases of all kinds. On their return they related to Abgar the wonderful things they had seen, and the implacable enmity and jealousy manifested toward Jesus of Nazareth by the Jews, who were seeking to bring about his death. Now the toparch of Edessa was afflicted with an incurable disease, and on hearing this marvelous story he loved Jesus, and conceived the hope that he might be cured if he could meet the Divine Healer."

Abbé Gaffre, who has already published one book on the portraits of Christ and is preparing another, with the collaboration of M. Boyer d'Agen, recently discovered in Upper Egypt a curious Greek manuscript of the sixth century, written on gazelle skin, which contains a new version of the relations between Jesus and Abgar and a series of illustrations, painted on gold leaf and very well preserved, which form exceedingly valuable additions to the iconography of Christ.

The manuscript, which Abbé Gaffre bought from the descendants of an old Coptic family, commences with the ninetieth Psalm of David: *Qui habitat in ajutorio Altissimi.* This psalm is a promise of salvation to all who place their trust in the Most High, for parchments of this character were often worn as talismans. Then comes the following letter, written by Abgar the Just and conveyed to Jesus by the messenger Ananias:

"Abgar, toparch of Edessa, to Jesus, the good man and physician who has appeared at Jerusalem, greeting:

"I have heard of thee and of thy cures, how by words alone without drugs or herbs thou dost heal the sick and make the blind to see, the lame to walk, and the deaf to hear; that thou dost drive away evil spirits and heal those who suffer with chronic diseases, that a woman long subject to hemorrhages was healed by touching thee, and that thou dost bring the dead to life. Having heard these things concerning thee, O Lord, I have conceived in my heart that thou art either God himself or the son of God come down from Heaven to accomplish these things, and for this reason I supplicate and beseech thee, by these letters and prayers, to deign to come to me in order to cure the malady with which I suffer, and to do for my city that which is necessary to prevent any of my enemies from taking and destroying it. It has also been reported to me that the Jews are wroth with thee and wish to put thee to death. Now, I have a small and modest city, but it will suffice for both thee and me."

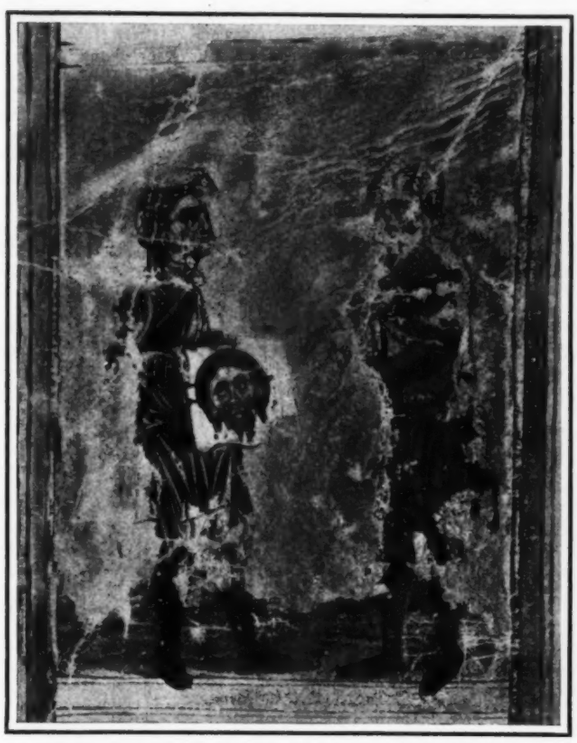
The manuscript goes on to say that Jesus, having received the letter of Abgar, sent the following reply:

"Thou art fortunate, O Abgar! thou and thy city which is called Edessa. Thou art fortunate, for thou hast believed in me although thou hast not seen me, and health shall return and abide with thee. Concerning my coming to thee, it is necessary that I complete the mission for which I was sent hither and then return to my Father who sent me. Thereafter I will send thee one of my disciples, Thaddeus or Thomas, who will cure thy malady and grant thee life eternal, and will protect thy city from thine enemies until the end of time. Amen. For I have descended from Heaven to save the human race and I have inhabited a body born of a virgin in order to efface the sojourn in the paradise lost by Adam, and I have abased myself to magnify you."

The letter was accompanied by the following note: "Wherever it shall find thee, on the road, in a house, before a court, in a moment of suffering and sorrow, at sea, in danger, in the heat of battle or in any other circumstances, this letter written by me shall dispel all thy troubles, for it is unassailable and a sure remedy and succor in every case. Therefore the bearer of it, if he is pure and upright and free from all vice, shall possess it for the healing of the soul and the body, as a talisman of unfailing power, because it is written with my own hand and I have sealed it with seven seals, beginning with the seal of Jesus Christ the son of God. . . ."

When Abgar had received this letter, informing him that he could not see Jesus, he wished at least to have a portrait of him. The manuscript continues:

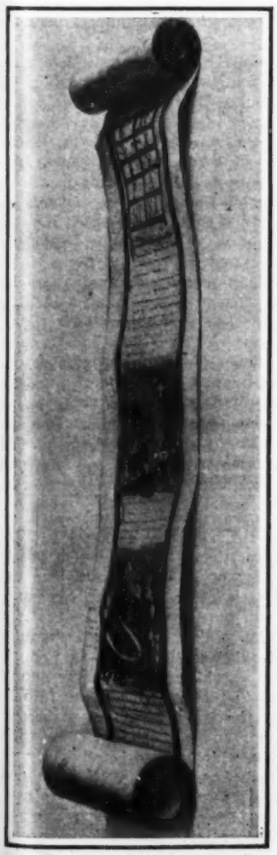
"Then Abgar sent a messenger, who was also an artist, to make a portrait of the Lord Jesus. When the messenger arrived at the gates of Jerusalem, Jesus said to him, 'Thou art a spy,' but the messenger replied: 'Lord, I am not a spy, but an envoy of Abgar, toparch of Edessa, and I wish to look upon Jesus of Nazareth and make a portrait of his face.' Then Jesus invited the artist into the synagogue. The



An enlarged copy of one of the miniatures of the Greek parchment, showing the messenger exhibiting the cloth which bears the portrait of Christ.

Abgar receiving the portrait of Jesus.

The miraculous portrait of Jesus Christ, preserved in the Church of St. Bartholomew in Genoa.



A Greek Parchment of the Sixth Century, found in Egypt by Abbé Gaffre, which contains a new version of the story of the portrait of Christ sent to Abgar, King of Edessa. The parchment is 11 feet long and 2½ inches wide.

Abgar handing his letter to the messenger.

Jesus receiving Abgar's letter in which Abgar prays that he may be healed of a malady with which he suffered, so that he might be able to resist his enemies. He also offers a refuge to Jesus from persecution.

Above, the messenger holding the cloth on which the portrait of Jesus has been imprinted. Below, two soldiers observing from a tower the pillar of fire which indicates the hiding place of the portrait of Jesus.

artist mounted to a high place, whence he studied the face of Jesus, who was teaching the people, but a divine power prevented him from fixing the likeness on the canvas. Jesus then washed his face with water and dried it with a cloth which, thus impressed with the portrait of his divine countenance, he dispatched to Abgar by the messenger. When the messenger arrived at Herapolis he stopped at a *cramarium* [a word of unknown meaning] and hid the cloth bearing the divine image. That night a pillar of fire appeared in the sky over the place where the portrait of the Lord Jesus was concealed. Beholding this miracle, the watchman of the tower called out with a loud voice, and a multitude came forth and beheld the *cramarium* in flames. The messenger, having been seized and accused of being the author of the conflagration, divulged the secret of the letter and the divine image was discovered to the eyes of the people."

Eusebius of Cesarea and Moses of Korene, two historians of the fourth century, give the story substantially as above. Protected by the divine image, the messenger reached Edessa in safety, and King Abgar was cured of his malady.

The precious relic, the palladium of Edessa, remained in that city until the tenth century, religiously cherished by the Mosiems, who had meanwhile obtained possession of Edessa. In the year 944 the Byzantine emperor Romanus Lecapenus obtained from the emir of Edessa permission to remove the divine image and the letter of Jesus to Constantinople, where they were received with fitting solemnity on April 16, 945. The portrait was preserved in the imperial palace, and later in the temple of Pharos, where it was set in a frame of gold ornamented with small pictures and arabesque designs, which concealed everything except the face of Christ. In this form the portrait passed into the possession of the doges of Genoa in the fourteenth century, when the emperor John Palæologos presented it to the doge Leonardo Montaldo in return for aid in war. At Genoa the relic was deposited in the church of St. Bartholomew, where it remains to this day, after having been taken away and restored many times—for example, by Louis XII. of France in 1507. It is preserved in a secret tabernacle guarded by six locks, of which the keys are kept by the six leading families of Genoa. On the day of Pentecost and the two following days, the tabernacle is opened, and the sacred image is presented for the veneration of the faithful.

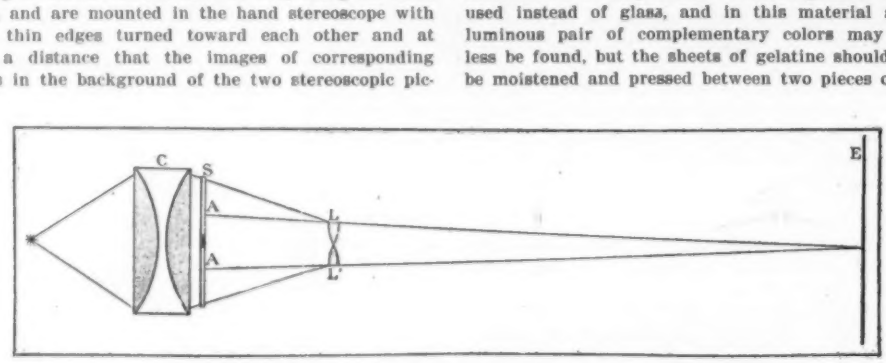
The illustrations which accompany this article show some of the best preserved of the miniatures of the parchment, but they convey no idea of the beautiful coloring of the originals.—Translated for the Scientific American Supplement from L'Illustration.

STEREOSCOPIC PROJECTION.

A SIMPLE METHOD THAT CAN BE PRACTICED BY ANY PHOTOGRAPHER.

BY T. THOVERT.

The following simple method of stereoscopic projection can be practised, with very little expense for apparatus, by any amateur photographer who possesses a projecting lantern. The objective of the lantern is removed and for it is substituted a double objective consisting of the two half lenses of a cheap stereoscope. These half lenses are usually made by cutting a double convex lens in two, along an axial plane, and are mounted in the hand stereoscope with their thin edges turned toward each other and at such a distance that the images of corresponding points in the background of the two stereoscopic pictures fall on corresponding points of the retinas of the eyes. For use in projection the lenses are left in the same relative positions (the reverse of their relative positions in the uncut lens), but are brought somewhat nearer to each other, in order to throw the images of corresponding points approximately to the same point on the screen. The distance between the lenses, consequently, depends upon the distance of the screen or the degree of magnification that is desired. It would be easy to deduce a formula for the distance between the lenses in terms of the distance of the screen, but it is still easier to make the adjustment mechanically in each case. For this purpose the lenses are inserted in the lantern and one of them, say the right hand one, is covered. The focus is next adjusted until a sharp image of the left hand picture is obtained with the left hand lens. Then the right hand lens is uncovered and moved toward or from its mate until the image which it forms of the right hand picture coincides approximately with the image already on the screen. Exact superposition is not required for the production of the stereoscopic effect by this method.



A SIMPLE METHOD OF STEREOSCOPIC PROJECTION.

The arrangement of the apparatus is shown in the accompanying diagram, in which *C* indicates the condensing lenses of the lantern, *S* the double stereoscopic slide, *A A'* corresponding points of the two pictures, *L L'* the pair of stereoscopic lenses used for projection, and *E* the screen. The lines *A L* and *A L'*, which meet in a point at the screen, represent the axes of the effective pencils, which produce the nearly coincident images of the corresponding points *A A'*, and *S L* marks the boundary of the converging cone of light from the condensers.

If the stereoscope lenses are very large their inner edges may overlap when the images are brought into coincidence. In this case it is advisable to cut a strip off the inside of each lens—or to use smaller lenses.

The stereoscopic effect is obtained by covering one lens or picture with red glass, and the other with green glass, and viewing the screen through plane eye glasses; red for the eye for which the red image is intended and green for the other eye. The light colored ruby glass used in dark room lanterns and a green glass which is also sold for dark room illumination give the best results. It should be observed that the images seen by this method are not very bright and for this reason strong illumination and sharp focusing are required. The glasses should be as nearly plane as possible in order not to add to the defects of the cheap lenses. Colored gelatine may be used instead of glass, and in this material a more luminous pair of complementary colors may doubtless be found, but the sheets of gelatine should either be moistened and pressed between two pieces of glass when in use, or moistened and allowed to dry between waxed glasses, in order to assure plane surfaces and, above all, transparency.

For very small pictures a condenser 4½ inches in diameter will suffice; 2½x5 slides require a 5½-inch condenser, while larger sizes up to 2¾x5½ can be covered by a 6-inch condenser. The distance of the source of light behind the condensers should be so adjusted that the conveying cone just covers the stereoscope lenses, which occupy an area of about 1x2 inches. If the source of light is of small area (as in the case of the electric arc) the interval between the two halves of the slide casts a visible shadow and this should be made to fall on the line of separation of the stereoscope lenses.—Translated from Photo-Revue.

ARTIFICIAL SILK.

The manufacture of artificial silk is continually being improved and its consumption increased. The various methods of manufacture are based on the same principle, the conversion of cellulose by chemical treatment into a substance similar to that which the silkworm manufactures, by an unknown process, from the cellulose of mulberry leaves.

The transformation was first effected by the Mercer process, which was patented in 1851 and is still in use, in an improved form. In this process raw cotton is steeped in caustic soda and washed successively with acidulated and with pure water. The product, which is known as mercerized cotton, closely resembles raw silk and costs one-sixth as much as that article.

In the newer methods the cellulose is dissolved or liquefied, and in that form is spun into fibers, which are then freed from the solvents and other added substances, so that the finished product consists of pure cellulose, and yet presents the appearance of silk. Three principal varieties of artificial silk are produced in this way.

1. Chardonnet Silk.—By treatment with nitric and sulphuric acids cellulose is converted into nitro-cellulose, or guncotton, which is soluble in a mixture of ether and alcohol. In the Chardonnet process this solution, which is known as collodion, is forced by a pressure of 40 or 50 atmospheres through glass tubes of calibers ranging from 1/500 to 1/250 inch. As the fine filaments emerge from these tubes they are spun together and simultaneously exposed to a strong blast of air which carries away the vapors of ether and alcohol evolved by the collodion. These vapors are condensed to the liquid form and used in dissolving another portion of nitrocellulose.

The fibers thus obtained resemble glass in appearance and are very inflammable, as they consist wholly of a variety of nitrocellulose or guncotton. The inflammability is diminished and the appearance of silk is given to the fibers by immersing them in a solution of calcium sulphide, which denitrifies the nitrocellulose or, in other words, reconverts it into cellulose.

2. Glanzstoff.—By adding an excess of ammonia to a solution of a copper salt a deep blue liquid, which is called Schweitzer's liquid, and which dissolves cellulose, is obtained. The artificial silk known by the German name of glanzstoff is made, very cheaply, by mixing cotton with caustic soda and copper sulphate and dissolving the mixture in ammonia. The solution is spun in an acid liquid which precipitates the cellulose.

3. Viscose Silk.—Cellulose is attacked, though not dissolved, by alkalies and the product thus obtained is converted by addition of carbon disulphide into a viscous substance, known as cellulose sulphocarbonate, or viscose. In the manufacture of viscose silk, wood pulp is subjected to the action of caustic soda during forty-eight hours and the resulting product is treated with carbon disulphide during four hours. The viscose thus obtained is spun into fibers and then reconverted into cellulose by the action of acids or solutions of ammonium and sodium chlorides. It is then washed with sodium carbonate and finally bleached with hypochlorites. The process, though complex, is not costly and it produces a very glossy silk.

Artificial silk manufactured by these various methods costs about $1.75 per pound, one-third the price of genuine silk. It possesses the advantage of taking basic dyes easily and directly but it is far inferior in tensile strength to genuine silk. It is best employed in combination with the latter to form a cheap fabric which unites the advantages of both.

When the first French railway, extending from Paris to St. Germain, was solemnly inaugurated, one of the most celebrated cooks of the capital was engaged to prepare the traditional banquet which usually terminates a ceremony of this character. The culinary artist devised a choice and substantial menu, of which the *piece de resistance* was a filet of beef with fried potatoes—a dish which subsequently acquired the name *filet Chateaubriand Pont-Neuf*. A few minutes before the time at which the train was due the chef gave the order to plunge the potatoes into the boiling butter. But the train was late, as becomes a self-respecting suburban train, and in order to inaugurate a tradition which is still religiously followed. The half-cooked potatoes were withdrawn from the butter and thrown into a colander to await events. Ten minutes later the locomotive, covered with flags, entered the station. The potatoes were put back in the hot butter, where, to the astonishment of the disgruntled disciple of Vatel, they quickly puffed out and assumed the light, spongy, melting and delicious form so familiar to epicures. Thus did this noble dish first see the light on the memorable day when a French railway train first ran behind time; that is to say, first ran.

THE NEW MAP OF GREENLAND.

HOW GREENLAND REALLY APPEARS.

THERE will be issued in the coming year the first map of Greenland with its entire coast outlined excepting for a short distance along the western part of Peary Channel. A sketch map showing what it will be like has already appeared. At last the shape and the extent of the largest island in the world are known. The circumstances under which the survey sheets containing the information required to complete the map of Greenland were preserved to the world are very remarkable.

In the fall of 1907, after Mylius Erichsen, the Danish explorer, had completed his exploration of this unknown coast, he and his two comrades, Mr. Hagen, the surveyor and cartographer, and Jörgen Brunlund, were groping their way southward in the growing darkness under the most desperate circumstances. Their excessive labors and their bitter privations toward the last had sapped their strength; their bodies were frost-bitten and they were on the verge of starvation. To preserve if possible the great result of their work, these survey sheets on which Hagen had outlined the unknown coast, they had put the invaluable papers in a bottle.

Southward they struggled on, but the strength of the two men was so far gone that they never reached any of the supply depots they had planted on their way north. They were at length reduced to a daily march of less than five miles and the catastrophe was at hand. Hagen died on November 15, and Mylius Erichsen succumbed ten days later.

The heroic Brunlund slung the bottle around his neck and staggered southward, though he was dying of hunger and his feet were half frozen. In the obscurity of the winter night he finally reached the supply depot on Lambert Land. The food he found probably brought a little comfort to his last days, but he was too enfeebled to recover any strength. He crept into a crevice of the rock near the food *cache*, where his body and the bottle containing the survey sheets were found by the search party last spring. Near by was the diary he had kept containing all that may ever be known of the details of the notable work that closed the pioneer stage of exploration in Greenland.

The more complete records that probably remained with Mylius Erichsen may never be recovered. The country was deeply buried under fresh snow and it was hopeless for the search party to attempt to find the bodies of the other men. But at any rate the map results of the survey of the unknown coast, which with its deep indentations and its projections into the Greenland Sea is about 1,000 miles long, are secure. This was the great purpose of the expedition, and these precious results have been rescued.

Soon after the return of the expedition to Denmark last summer Commander Trolle of the Danish navy, who took command after the disappearance of its leader, prepared an account of the work which was printed in parts for several days in the National Tidende of Copenhagen. The report was illustrated by a map made from the survey sheets of the whole coast from south of Port Denmark, the winter quarters of the ship, to Cape Bridgman, in the archipelago north of the Greenland mainland, discovered and named for Peary. The map is now reproduced in La Geographie of the Paris Geographical Society with many details of the work. The chart is presented as a "provisional map of the northeast coast of Greenland." Undoubtedly a more refined and accurate reproduction of the survey sheets on a large scale will soon be produced. Meanwhile the new map shows very clearly the general features of the new coast and it treats us to some conspicuous geographical surprises.

Only a few islands and a bit of the mainland had been found by the Duke of Orleans to lie east of 20 deg. west longitude between Cape Bismarck and Cape Bourbon, the most northern point reached by the Duke's expedition. From the trend of the coast it was thought that it probably extended to the northwest to the Independence Bay of Peary. This idea is dispelled by the Danish discoveries.

In about 80 deg. 40 min. north is a great peninsula to which Mylius Erichsen gave the name of Amdrup Land. It is at least fifty miles in width and stretches far east over the Greenland Sea to about 12 deg. east longitude. Its terminus at Cape North East is the most eastern point of Greenland and extends the mainland about a fifth of the way across the inland sea toward the latitude of West Spitzbergen. This discovery has an important bearing upon the ice drift that brings a great deal of floe ice from the frozen ocean to the north. This ice often blocks the east coast of Greenland and if it was not for the Great Barrier now discovered it is likely that the coast south of it would seldom be approachable.

Just north of Amdrup Land Mylius Erichsen discovered one of the largest fiords in Greenland and named it Denmark Fiord. He mapped the whole of it and found it to be about eighty miles in length. To the north of Amdrup Land a smaller fiord was found and named Hagen Fiord. It opens in Peary Channel.

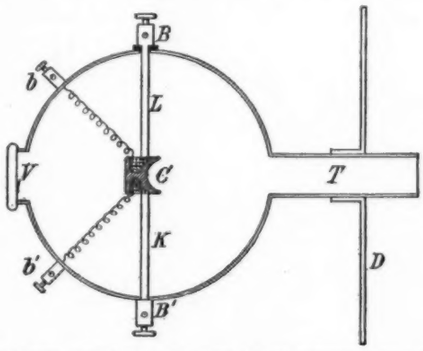
Another great discovery was that Peary Channel extends clear across the north coast of Greenland, reaching the Greenland Sea only a little west of the most eastern point of the archipelago to the north. According to the new map Peary's Independence Bay appears to be only a widening of Peary Channel, which narrows again, and all the way to the Greenland Sea it is a comparatively narrow waterway. The Danish survey extends along the Greenland coast to Cape Glacier, which is shown on our maps as the northeast point of the mainland. It is, however, far west of the sea and fronts on Peary Channel. A deep fiord whose mouth is indicated on Peary's map on the north side of the channel was explored to its terminus and named Brönlund Fiord.

Mylius Erichsen's determination to connect his surveys with those of Peary at Cape Glacier cost three lives. There is little doubt that if he had been content to turn back after he had reached the southern shore of Peary Channel he would have returned to his supply depots in safety, but he rounded out his work by pushing west to Cape Glacier and proving that the waterway before him was Peary Channel. His final discoveries were made at fearful cost, but at least the fruits so hardly won have been preserved to complete the map of Greenland.—New York Sun.

APPARATUS FOR MEASURING THE HEAT OF THE SUN.

By OUR PARIS CORRESPONDENT.

IN a paper presented to the Académie des Sciences by Messrs. Millochau and C. Fery upon their researches as to the heat of the sun, they describe a new instrument which they devised for this purpose. What they wished to do was to compare the measurements made in the last two years with a new pyroheliometer, with the measurements usually made by the use of an actinometer. These latter apparatus can give the total quantity of heat from the sun, so that we can find the solar constant. In another paper they expect to show how the readings of the pyroheliometric telescope can be used so as to give the solar constant, which it is so important to know and whose different estimated values vary up to 50 per cent. The main difficulty in the use of actinometers lies in the fact that they are standardized in absolute values. In Angström's instrument, adopted by the solar research congress, the method of reduction to zero was resorted to; the two joints of a thermo-electric couple can be heated at the same time, one by the sun's rays and the other by an electric current, so that we can obtain a zero reading when the two joints have the same temperature. Should both joints be exactly alike, we can thus measure the solar energy directly, but in practice this is scarcely possible. Besides, the operation is delicate, and the whole apparatus hardly portable. A thermo-electric actinometer is analogous to a balance whose two arms are unequal. The most simple method to make a measurement is therefore to use the process of double weighing. On one joint we act with an electric current and can standardize the instrument, finding the curve. It is connected to a millivoltmeter of proper sensitiveness and at the moment of observation, when the same joint is exposed to the sun's rays, the simple reading of the voltmeter dial will show the electric energy and thus the number of calories which measure the solar radiation. As all the conditions are the same, this method of substitution will raise no objections. The instrument is mounted as follows: At the center of a metal sphere, nickel-plated on the outside and blackened inside, we have two rods, one of brass, *L*, and the other of constantin alloy, *K*, which support a small metal piece, *C*, called the "receptor." The latter acts as one part of the thermo-electric couple which is heated, while the part which is cooled is the point of junction of the constantin rod to the sphere. The brass rod is insulated from the sphere. A tube *T* admits the sun's rays into the apparatus, and this tube supports a screen of cork covered with tinfoil, *D*, so as to keep the sun's rays off the sphere. A ground-glass screen, *V*, allows us to see, by means of the centering of the shadow thrown by the receptor, whether the position of the sphere is correct. The part *C* is formed of red copper with a concave and blackened face turned toward the outside. It is wound with manganine wire which receives the standardizing current through the binding posts *b b'*. It is then easy to graduate the instrument in calories, as it is connected by *b b'* with the voltmeter. The sphere is only four inches in diameter.



A NEW APPARATUS FOR MEASURING SOLAR HEAT.

The apparatus is pointed in the direction of the sun and kept there as well as possible. Then by reading the deflection on the voltmeter and noting the time at the moment when the reading was made, we can trace a curve, taking the time as abscissæ and the voltmeter readings as ordinates. Comparing this curve with one which a pyro-heliometric telescope gives we find that the actinometer shows a certain inertia due to the mass of active metal, which is more than 1,000 times the active mass of the pyro-heliometer. The retardation is 23 minutes. This effect is found in all actinometers whose receptor has a non-negligible mass, and it gives errors in the study of atmospheric absorption, making it necessary to apply a certain correction to the instrument.

The present apparatus was used on the summit of Mont Blanc, and the value of the solar constant was found to be 2.38 calories. It was also directed toward an electric furnace at different temperatures. This comparison, which served to check the standardizing, can also be used to give an estimate of the mean effective temperature of the sun. We apply Stefan's law to the results found with the furnace and with the sun, taking account of the apparent surface of the radiating sources. The constants determined by three measurements led to the following results: Furnace at (a) 1,663 deg. absolute, (b) 1,623, (c) 1,280. Sun (a) 5,696 deg. absolute, (b) 5,695, (c) 5,567. This estimate has not the precision of the values found by the pyro-heliometric telescope, on account of the small effect given by the furnace and the want of precision in taking the value of the apparent surface, but it gives a very good check upon the electric standardizing of the actinometer.

OUR LOSS BY FIRE.

THE annual fire loss in the United States is the subject of a vigorous appeal to the public from President J. Montgomery Hare of the National Board of Fire Underwriters. He states that the total property loss by fire in this country in 1907 was nearly $200,000,000, while the average for the last five years has been over $251,000,000. Losses by fire are unlike most losses, in that they represent a total destruction of property. If money is put into a manufacturing enterprise it is all paid to somebody for materials, labor and equipment, and if the venture is unsuccessful the money will have had some useful purpose, and some assets will remain, but if an investment is made in a building which is later destroyed by fire the loss is much more complete. In spite of our boasted pre-eminence in engineering and building, the annual per capita fire loss in the United States is almost ten times that in the leading European countries; to be specific, it is $3.02 in the United States, 29 cents in Austria, 26 cents in Denmark, 30 cents in France, 49 cents in Germany, 12 cents in Italy, and 30 cents in Switzerland. We have 4.05 fires to each 1,000 population in our cities, while the figure for Europe is only 0.86. In Europe fires are confined almost invariably to the buildings in which they originate, while here it is not unusual for them to spread from one structure to another, owing to the low standard of construction as respects resistance to fire which we have.—Engineering Record.

Bleaching Soda (Henckel).—A washing fluid, with the aid of which dazzling white washing is assured, is made by mixing soda with waterglass and a few per cent of tallow soap and starch powder.

ENGINEERING NOTES.

Centimeters and Inches.—In the July issue of Révue de Mécanique, M. Haouy points out that while 1 inch = 2.5399541 centimeters, the ratio 160/63 (= 2.53968) can be used for all practical calculations, it being less than the hundredth part of one per cent below the true value. Conversions can be readily made on the slide rule by using the proportion: Inches : centimeters :: 160 : 63.

American lake shipyards launched fifty-six vessels in 1907, of which forty were bulk freighters, three package freighters, one passenger steamer, one salvage steamer, one lighter, one mail boat, five tugs, and four scows. Only one vessel, a tug, was built in Chicago, but eight freighters and two package freighters were built in Detroit. There are on the stocks, for 1908 delivery, twenty-four freighters, against forty-five at the beginning of 1907.

During the year 1907, 4,267 vessels of a net tonnage of 14,728,434 tons passed through the Suez Canal as compared with 3,975 vessels of 13,445,504 tons in 1906, showing an increase of 292 vessels and of 1,282,930 tons. Of these 4,267 vessels 3,254 were merchant vessels—including 218 in ballast—920 were mail steamers, and 93 warships and government transports. The transit receipts were 116,000,096f. as against 108,161,896f. in 1906, an increase of nearly 8,000,000f.

Effect of Superheated Steam on Mineral Cylinder Oils.—According to Messrs. G. W. Worrall and J. E. Southcombe, in a recent issue of the Journal of the Society of Chemical Industry, (1) no chemical change of a hydrocarbon cylinder oil takes place in a cylinder using steam which is not heated up to 750 deg. F. (2) The deposits consist chiefly of oxide of iron, which is formed independently of the oil. (3) The adhesion of the oxide producing deposits depends upon the pitchy constituent in the oil and the completeness of distillation. (4) The oil is fractionated by the steam, the shape of the cylinder and adjacent parts, and the temperature influencing the quantity of pitchy matter remaining behind.

An interesting salvage feat was accomplished a short time ago by the Liverpool Salvage Association, which constitutes a record in such operations. The steamer "Veronese," carrying a valuable cargo, foundered with a gaping hole in her bow. The task of attempting to salvage the vessel was taken in hand by the Liverpool Association. Owing to the peculiar condition prevailing, it was at first considered expedient to discharge the cargo, patch the rent on the inside, and then raise the ship, but the chief engineer finally decided to make an effort to save the whole intact. This was a somewhat difficult task, since it entailed work being carried out at a depth of about 30 feet by divers. The project was deemed possible by means of new pneumatic tools recently devised expressly for submarine operations. The divers surveyed the patch and collected careful measurements. With this data a sufficiently large single steel plate was prepared on board the salvage steamer, and a staging slung over the wreck to a depth of 28 feet, upon which the divers could work. Holes were drilled in the hull around the hole, the plate was lowered and slung into position, and by means of patent bolts invented by the Association's engineer a water-tight repair completed. The ship was then refloated, the cargo not having been touched at all, and the repair was found to be so sound that it was decided to take the boat direct to Liverpool for overhauling. The hazardous journey was safely completed despite variable weather and passage through the Bay of Biscay.

Concrete Paving for Streets.—Over 500,000 square yards of a new system of concrete paving, the invention of Mr. Rudolph S. Blome, of Chicago, have been built or are under contract at Gary, Ind., Chicago, Washington, D. C., and other places. These pavements, as described in a recent issue of Engineering News, consist of a 1:3:4 concrete base 5¼ inches thick, and a surface blocking 1¾ inches thick, making a total of 7 inches, exclusive of the foundation, which latter is a layer of coarse sand 4 inches thick. The surface blocking contains 1 part of Portland cement and 1½ parts of clean, crushed monument granite, from which all dust has been screened. One-half of the crushed granite is ¼-inch size, 30 per cent of ⅛-inch size, and 20 per cent of 1/16-inch size. This proportion of sizes is said to be absolutely essential to produce proper results. The surfacing is deposited on the concrete base before the latter has begun to set, and is worked into brick shapes approximately 4½ × 9 inches, with rectangular surfaces, similar to paving blocks. Expansion joints are placed across the pavement at distances not exceeding 50 feet apart. These joints extend though the surfacing and concrete base and are filled with a specially prepared plastic composition. It is claimed that the surface of this pavement will not become slippery by wear, that it costs less than pavements made of other materials and will wear much longer, and that when laid against the rails of street railways it is not injured by the car traffic and does not crack or disintegrate.

SCIENCE NOTES.

In order to ascertain what really takes place when coal is submitted to a moderate rise of temperature with limited access of air in closed vessels, Dr. Habermann carried out a series of experiments at Munich with different kinds of coal, which were broken up into small fragments about the size of peas, and kept for eight days in iron retorts heated to a temperature of 142 deg. C.; two 1¼-inch air pipes were inserted near the bottom of the retort, but there was no other opening. Some kinds of coal heated rapidly, and ultimately reached a temperature of 350 deg. C., but with other descriptions of coal the rise in temperature was less marked.

Two papers were presented before the American Electro-chemical Society by H. T. Barnes and G. W. Shearer in conjunction with H. M. Tory and G. H. Cole, in which the results of experiments on the effect of dissolved gases in water on metal surfaces have been given. In the second paper a cell was described which consisted of electrodes of aluminium and magnesium in a solution of aluminium sulphate, to which some hydrogen peroxide was added. Aluminium behaves in a peculiar manner in contact with dissolved air, or oxygen, and becomes electro-negative to a similar aluminium electrode in water free from dissolved air. Magnesium does not show this effect; hence a cell with the two metals for electrodes has a comparatively large E. M. F. developed when dissolved air or oxygen is introduced. The effect is considerably increased by adding hydrogen peroxide. Acting on the suggestion of Prof. Bancroft, tests were applied to the water in which clean aluminium had stood for a few hours, and a measurable quantity of hydrogen peroxide was detected. This was developed from the action of the dissolved oxygen on the aluminium, probably according to the following reaction, also suggested by Bancroft:

$$2Al + 6H_2O + 6O = Al_2(OH)_6 + 3H_2O_2.$$

The amount of yield of the peroxide was considerably increased in several ways. Without dissolved air no trace of peroxide was observed. The generation of the hydrogen peroxide explains the abnormal E. M. F. developed between two metals so close together in the electrochemical series.

According to A. Stephenson in the Philosophical Magazine, the phenomena of phosphorescence may be very closely imitated by a mechanical model. He describes the principle as follows: "Consider a particle suspended from a fixed point by a light elastic string; if we regard the system as confined to a vertical plane it is fixed by two co-ordinates, and the normal motions are the vertical vibration and the horizontal (pendulum) swing. If the system is frictionless—a case which may be considered by way of introduction—the normal motions are in general practically independent; the vertical vibration creates a small periodic change in the spring of the pendulum motion, while the latter exerts a second order forcing disturbance on the former, but neither of these actions is cumulative in effect unless the periods are properly adjusted. When the periods vertically and horizontally are approximately in the ratio 1/2 there is mutual interaction: if the system is initially in vertical motion, any small horizontal swing is gradually magnified through the periodic change of approximately double frequency in its spring; while if, on the other hand, the motion is initially horizontal, a vertical vibration is forced by the isochronous variation in the tension. Now let us suppose that the vertical co-ordinate is subject to kinetic friction, while the other is frictionless. Then, whatever the relation between the periods, the pendulum motion forces a small oscillation vertically, in general of second order amplitude, maintaining it against friction; thus the energy is gradually dissipated and the frequency of the emission is double that of the pendulum. Consider the effect of a periodic disturbance applied radially. In general it will merely produce an isochronous forced vibration vertically, but if the frequency is approximately double that of the pendulum motion, this oscillation will in turn magnify any existing small pendulum swing; thus the system stores energy absorbed from incident disturbance of the particular frequency. For a given intensity of disturbance the amount of energy obtained in this way will depend upon the time of action, but evidently it must have some definite upper limit. When the exciting force is removed the pendulum motion generates a comparatively small forced oscillation vertically of double its own frequency, which continues until the energy is dissipated against the kinetic friction. Thus the system gives out the stored energy in a definite frequency during an interval which is comparable with, and may indeed be large compared with, the time of action of the incident disturbance. That is, the system "phosphoresces." Anderson works this out mathematically and quantitatively, and shows that all observed phosphorescence effects are paralleled except phosphorescent hysteresis.

TRADE NOTES AND FORMULÆ.

Imitation Amber.—The patented imitation amber of R. and A. Roessler, Gablonz, Bohemia, consists of 1 part of pine resin and 1 part each of Lacca in tabulis and white rosin, which are carefully melted together.

Blown oils are made by heating fatty oils, like rapeseed, cottonseed oil, etc., to 158 to 167 deg. F. (70 to 75 deg. C.) while blowing through a current of atmospheric air until the specific gravity is about the same as castor oil. By this process, a much greater saponifying power is imparted to many oils than they possess in an unblown condition.

Bronze Pencils.—Bronze powder is thoroughly mixed with finely washed clay and dissolved gum, and to improve the hold of the stroke on the marked substance, as well as increase brilliancy, some fat is added. The formation of the mass into strips and its subsequent treatment, is effected with the aid of machines employed in making lead pencils.

Autographic Ink.—110 parts of wax, 30 parts of tallow, 110 parts of soap, 50 parts of shellac, 40 parts mastic, 10 parts pine rosin, 30 parts of lampblack. Mix these substances together in an iron vessel, increase the temperature until unpleasant-smelling vapors are developed, and pour the mass into molds or make with it cylinders by rolling it on a flat stone. These are then to be used by rubbing them down with water in a porcelain saucer.

Drawings in Bronze on Class Plates.—After the glass has been polished clean take a solution of isinglass, the same as used for gilding, and by means of a soft otter's hair brush, apply it quickly to the glass. It is of course understood, that the solution must be carefully filtered. Then the glass is held by the corners, obliquely over the flame of a lamp, so that the fluid runs off until it is perfectly dry. The position must not be changed, otherwise ridges will be produced on the surface. When the glass has been prepared in this manner write firmly on it. By this means, lettering, etc., in microscopic proportions, can be done. It is best to use a drawing pen. The glass remains perfectly clear and clean and it is not necessary to wash it off. Aquarelle colors may also be used and for outlining, India ink.

Printers' Roller Mass.—Weigh out equal parts of glue and glycerine, keep the glue covered with water until it assumes a leathery consistency; then it is laid in a sieve and the water shaken off; then both glue and glycerine are placed in a vessel over a slow fire, or better, in a water bath, melted and poured about the core, in clean molds, painted with oil. For this purpose bone glue of low adhesive power, that will swell in water without liquefying, is best. The casting of the rollers is effected in molds made from sheet or cast iron; the latter are always in two parts and can be closed, by means of a hinge and projecting pins, or by screws. Before pouring, the inside of the cylinder should be carefully coated with oil, to prevent sticking of the mass, and the roller pin must be set exactly in the center and especially fastened securely at the upper end, so that a displacement in the mass will be prevented and it will not be lifted up by the glue mass when the mold is filled. When the mass has attained the proper degree of fluidity the kettle or other vessel used for melting can be removed from the water bath and any froth or scum formed skinned off by means of a spoon; after the agitation has ceased, the mass is poured slowly into the cylinder, care being taken to avoid the formation of bubbles or foam, which are injurious to the homogeneity of the roller. The pouring being completed, the roller remains in the cylinder until completely cooled, so that it can be withdrawn from the end of the sheet metal mold, or taken from the two-part mold when open. The finished roller is cleansed by wiping with a woolen cloth, the rough edges trimmed, and it is kept hung up in an airy place until ready for use 24 hours later. The finished rollers are made more durable if given a coating with a solution of 50 parts of dichromate of potash in 950 parts of water.

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